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FORAGES:

PRODUCTION, HARVESTING, UTILIZATION

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ECONOMIC CONSIDERATIONS

C. W. Loomis

The ability to produce low cost feed in the form of forages is a valuable resource on New York dairy farms. The manner in which a farmer uses his forage production capability determines, to a large degree, financial success or failure in his farming operations.

The physical resources on all farms are limited and there are many alternatives for their use. In both the basic organization and in the continued operation of his forage program, the successful farmer will look at all of the uses for his capital, his land, and his labor and will choose the combination of uses that will offer the highest return.

This bulletin deals with some of the considerations a farmer will want to take into account when planning his forage program. It represents the combined judgment of several individuals in the various departments at the New York State College of Agriculture concerned with the production and use of feed in the form of forages.

Characteristics of the land—its soil, its topography, and climate—vary from area to area and from farm to farm. These differing physical conditions dictate to a large extent the kinds of forage crops that can be grown, and place ceilings on the yields that can be obtained. Within these limitations, economic considerations will determine the amounts of crops to be grown, the yields that will be most profitable, and how they will be harvested.

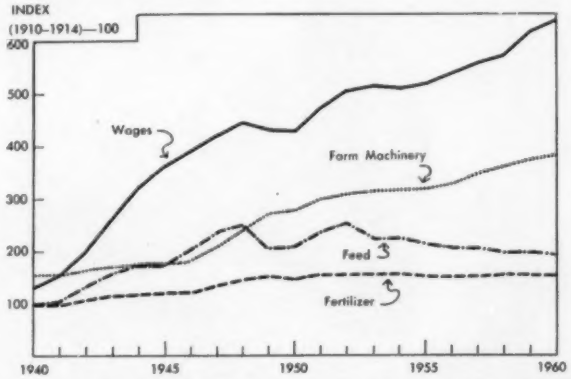
SELECTING THE FORAGE PROGRAM

Because of physical and economic differences, there is no one best choice of forage practices. The most profitable investment for a farmer who is feeding low quality forage to his dairy herd may be in better harvesting and storing equipment. On the other hand, the best move for his neighbor who has high quality forages but produces too little to feed enough cows to keep himself and his labor force fully employed throughout the year, may be to provide better yields through more intensive management or to purchase additional land to enlarge the business. These and other differences in farm strengths and weaknesses make it difficult to give blanket recommendations for such common questions as, "Will it pay me to install a hay dryer?", or "Should I make grass silage?" The choices of the type of equipment, the kinds of crops, or the size of the business cannot be distinct and separate problems but must be considered together if maximum profits are to result.

THE LABOR RESOURCE

The total working force (the operator, his family, and hired help) is one of the most stable aspects of the farm business. Over a period of time a dairyman may add more cows, more equipment, and more land but it is unusual for him to change the size of the labor force. Moreover, the labor force on most dairy farms tends to remain relatively stable throughout the year. Additional help during peak work seasons is very often family labor otherwise occupied during the school year.

The per man output of workers in the United States is increasing. With increasing productivity, the hourly cost of farm labor has become relatively greater than many other farming costs. Between 1940 and 1960, the price paid for farm wages increased more than five times. During the same period there were increases in other costs, but the rise was less than occurred in wages. An important consideration in the choice of a crop and livestock system, therefore, is one of keeping the labor fully employed. In a very real sense, a farmer



Prices paid by United States farmers for feed, fertilizer, machinery, and wages.

Source: *Agricultural Prices*, Agricultural Marketing Service, U.S.D.A.

sells his labor and in so doing he wisely selects enterprises that use the help available throughout the year.

In recent years in many areas of the State, some grain crops have shown relatively high returns for the amount of time spent producing them. But the fact that the returns are high for time spent on grain crops does not necessarily mean that a wise dairyman will greatly increase his grain acreages. Grain acreage is usually expanded at the expense of the forages. The total amount of forage available is related to the number of cows that can be kept. Reduced numbers of cows mean less work in winter. A wise dairyman adjusts his operations in keeping with changing returns from the various enterprises on his farm, but he will always keep in mind that it is the total returns for the full year that determine profit, rather than the returns for a limited period of time.

THE LAND RESOURCE

It has been pointed out that the land resource is a major determinant of the kinds of forage crops that can be grown. Its commanding role among the various resources on a farm is strengthened by the fact that its shortcomings are least easily corrected. Lime can be added to correct acidity, and tile or other physical means will correct some drainage difficulties. But present day technology offers few, if any, economical ways to change effectively the basic structural characteristics of the soil. The farmer whose land is a seriously limiting resource will consider these alternatives: the cost of a loss in production of forages if the deficiencies are not corrected; the cost of making whatever corrections are possible; and the cost of moving his farm operations to another area with better soil.

Dairymen who are operating good quality, relatively high-cost land, with limited opportunities for the acquisition of more land, will choose intensive operations with frequent seedings and heavy fertilization programs. It is this group who may economically justify a system where a large portion of the forages are brought to the dairy cow. On the other hand, the operators of lower quality soil who have opportunities to rent or purchase additional land at reasonable cost will operate more extensively and with longer rotations. They will recognize that yield potentials are different on different quality soils.

CAPITAL RESOURCES

The operator who has adequate cash and credit may economically choose investments that take a long time to recover. His neighbor with extremely limited capital will choose investments that require less capital and afford more rapid turnover, but perhaps allow more chance for loss in the event of unfavorable weather or other conditions.

The dairyman with limited capital will frequently choose ways of providing forages that involve a high use of labor rather than capital. This is one reason why some dairymen will use a trench silo rather than a more permanent upright type, or will harvest a neighbor's crop of hay on a share basis rather than purchasing nitrogen to improve his own forage stands.

THE PRODUCTION OF FORAGES

W. L. Griffeth

THE INFLUENCE OF CLIMATE

Climate is of great importance in the choice of crops and varieties, in determining crop yields, and in influencing harvesting and storage problems.[1]

Growing season and summer temperatures

The growing season is generally considered to be the time from the last killing frost in the spring to the first in the fall. There is great variation in length of growing season in different parts of New York State, although hay crops usually are less sensitive to the length of growing season than are other frost-susceptible crops.

There are important differences among crops in their response to temperature when moisture is adequate. Oats and meadows grow best in moderate temperatures. Orchardgrass tolerates high temperatures, but bluegrass and timothy do not. Bromegrass is intermediate in response to high temperatures. The forage legumes such as alfalfa, birdsfoot trefoil, Ladino clover, and red clover thrive under high temperature conditions, if moisture is adequate.

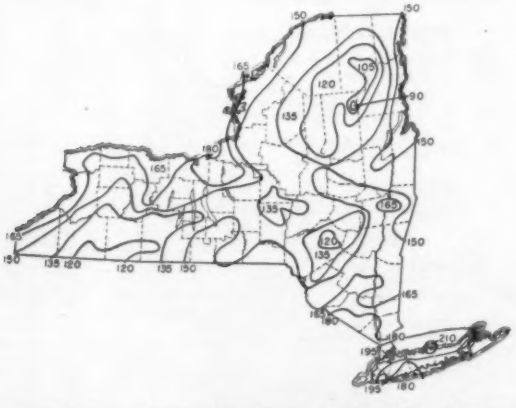
[1]Climate and its effect on crop production is discussed in more detail for New York State in Miscellaneous Bulletin 31, *Field Crops in New York*, New York State College of Agriculture.

The temperature in New York is influenced by latitude, elevation, and, locally, by nearness to large lakes.

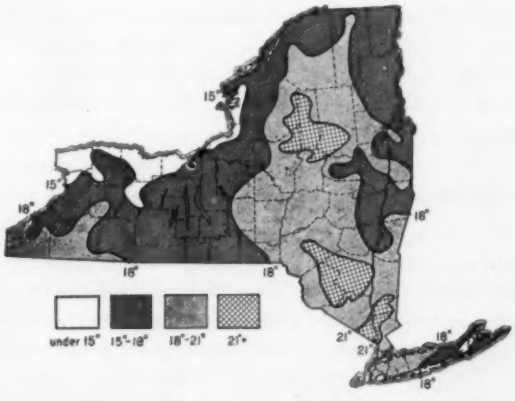
Rainfall

The average rainfall from May 1 to September 30 ranges from less than 15 inches to more than 21 inches. Fifteen inches of well distributed rainfall throughout the growing season, together with the normal reserve in the soil, is adequate for any field crop in New York. In approximately half of the years, however, there is less than 15 inches of rainfall. Often there are critically dry periods of two weeks or longer in years when the total growing season precipitation is average or above.

The various forage species respond differently to periods of drought. Native pastures of Kentucky bluegrass and white clover, for example, even though improved with lime and fertilizer, are much less productive in mid-summer in the areas of lower summer rainfall than in areas with more than 21 inches. To a lesser extent this is true also for grass meadows, particularly those made up predominantly of timothy. Drough resistant legumes, like alfalfa, are especially valuable in the belt with 15 inches or less rainfall from May through September. In areas with well-distributed summer rainfall, meadows made up predominantly of



Average length of growing season in days. The higher the elevation, the shorter the growing season.



Mean average rainfall for the growing season. The rainfall pattern is not always associated with average summer temperature or elevation.

grass produce throughout the growing season if adequate amounts of nitrogen are applied. In areas with high rainfall, the growth of hay and pasture is generally favored, but rainy weather often interferes with harvest. Here grass silage and mow drying are urgently needed for the early harvest of forages.

Severity of winter

Three soil and climatic factors, soil moisture, minimum temperature and snow cover, influence the likelihood of winterkilling of forage legumes. Winterkill is greater on wet soils than on well-drained soils. A few inches of snow cover insulate the soil surface and greatly reduce the effect of low temperatures. Snow cover also reduces the amount of late winter freezing and thawing of the surface soil which may cause more severe damage than very low temperatures.

In addition to the three factors listed above, the winter survival of forage legumes can be influenced by proper fertilization and management. Research has shown that adequate potassium is particularly important for legumes to build food reserves. Cutting or grazing time and frequency also influence the accumulation of reserve foods by legumes and grasses.

THE SOIL RESOURCES—LAND REGIONS[2]

There are over 300 soils in New York State that have a wide range of characteristics with differing requirements for successful management. They range in texture from sands to clays; droughty to very poorly drained; with or without blocky structured subsoils; with or without deep subsoil fragipans (hardpans); stony to non-stony; strongly acid to neutral and high to low in organic matter and in potassium supplying power. Widely different soils often occur in neighboring farms and sometimes within fields. Specific information on the individual soils can be obtained by studying a detailed soil map and by having the soil tested for acidity, phosphorus, potassium, and organic matter.

Understanding soils on individual farms

Within each of the major land regions, there are good and poor farms and fields. Most soils have certain natural advantages and some disadvantages. The challenge to farmers is to understand their own soils well enough to capitalize on the strong points and to minimize the special disadvantages. If, for example, a field has soil classed as somewhat poor drainage, it is inefficient to try to grow alfalfa; birdsfoot trefoil is better adapted to such soils. Perhaps an all grass system would be better than the rotation system with corn and small grains. At the other extreme, long-term hay is not likely to be the best system for a well-drained farm or on well or moderately drained, easy to work, fields on a specific farm.

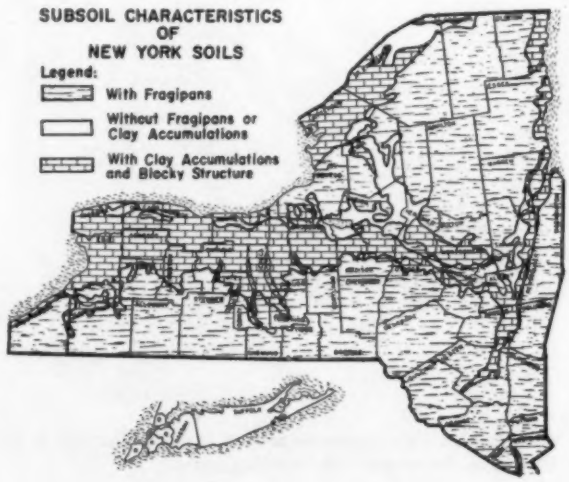
The important features a farmer should know about his soil are: kind of profile, drainage, slope, texture, pH or acidity, nutrient availability and stoniness. In connection with each, the following questions need to be answered: Why is it important? What does a farmer need to know about it and how can he learn it? What can be done to change the situation as it exists on the farm?

Kind of profile

For management purposes, New York soils can be placed into three groups: soils with fragipan (hardpan); soils with clay in the subsoil; and soils with neither pans nor clay in the subsoils.

Nearly all acid upland soils in the Southern Tier, Hudson Valley and North Country have a dense lower subsoil root barrier layer called a fragipan. Most soils in central New York and soils from clays in the North Country and in the Hudson Valley have a blocky structured clayey subsoil layer. In the Mohawk and Black River Valleys, both kinds of soil occur.

In soils having a hardpan, the pan is densest and closest to the surface on the wetter soils. It begins at 24 to 28 inches in well-drained soils; at 18 to 24 inches in moderate; 15 to 18 inches in somewhat poor; and



[2]See Cornell Extension Bulletin 930, *Soils and Soil Associations of New York* and Miscellaneous Bulletin 31, *Field Crops in New York* for more details on the soils and land regions in New York State.

10 to 15 inches in poorly drained soils. For good yields on these soils it is especially important for farmers to lime and fertilize liberally because the hardpans restrict root growth and water storage to the shallow layer of friable soil above the pan.

In soils with clayey subsoil, the depth to this layer is mainly related to natural lime content and not to natural drainage class. The subsoil begins at 12 to 15 inches in the high-lime soils and at 15 to 22 inches in the medium-lime soils. On the well and moderately drained soils having a clayey subsoil, plants root more deeply and use the stored water and available potash from this layer.

Most coarse-textured (sandy) soils and some gravelly-loam, strongly-acid soils in the state have neither fragipans nor clayey subsoils. Although crops can root very deeply in such soils, the sandy ones are usually very low in available nutrients and waterholding capacity. The gravelly loam soils are low in available nutrients but have good waterholding capacity and are very responsive to good management.

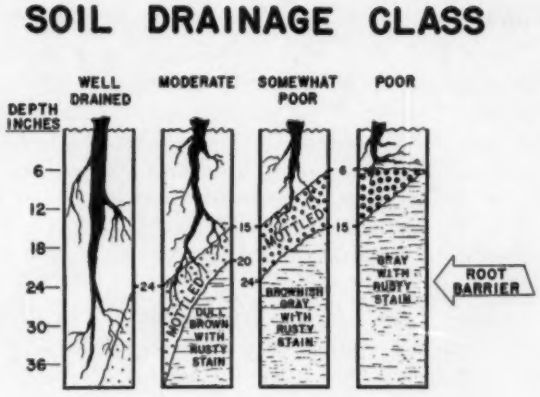
Drainage

Soil drainage is important because it influences the use of the land. As the drainage becomes progressively poorer, the yield potential becomes lower and the proportion of crop land in row crops decreases. Wetter soils are difficult to plow, fit, plant and cultivate on time. Therefore on these soils the trend has been away from the row crops like corn. Conversely the acreage of hay increases and meadows are left longer without plowing and reseeding.

Soil drainage is determined by two factors: the rate at which surplus water moves through the soil and out of the root zone and the amount of water that runs into or off the surface. The rate of water movement through a soil depends on the soil texture, structure, and water table relationships. Some soils that have a coarse texture and let water through at an acceptable rate must be considered wet because water flows into them from adjacent high ground. Fine textured silts and clays restrict the rate of water flow.

There are many fields where soil moisture conditions can be changed by protection from runoff or seepage from adjacent higher ground, and by use of properly placed diversion ditches. Drainage terraces within cropland also help in many cases. Tile drains may be the answer for removing excess water from the soils with blocky structured subsoils and those sandy soils without fragipans.

Cornell recommendations on land use, rotations, kinds of crops and seeding mixtures are related to the



drainage classes shown above. The very poorly drained soil is too wet for farming and is not shown in the diagram.

Each drainage class has a range of wetness indicated by the sloping mottled zones in the diagram. Properly designed tile drainage, open ditches, or diversion terraces usually improve soil moisture conditions for crops about one drainage class. Descriptions of the drainage classes follow:

Well-drained soils have a plow layer dry enough to work nearly every year by the time the grass begins to grow. The subsoil is rarely too wet during the growing season; there is no mottling to at least 24 inches; and sometimes the hardpan is below 24 inches. Some well-drained soils have no limit to root penetration.

Moderately drained soils can be worked in the spring with only slight delay. The upper subsoil is like that of well-drained soils with faint mottling below 15 to 20 inches.

Somewhat poorly drained soils stay wet until late spring. The subsoil is pale or dull colored and strongly mottled below 6 to 12 inches, showing that the subsoil is often wet. There sometimes is a hardpan at 15 to 18 inches.

Poorly drained soils are too wet to work in regular crop rotations. They are usually on flat land, and have a dark-gray plow layer and grayish subsoil with strong mottling.

Mottling is yellow, orange, gray, or rusty spots in the subsoil that indicate some degree of excess wetness of the soil.

Root barrier indicates that air is cut off for long periods by excess water; in some soils a hardpan also limits root penetration. Some legumes, such as birdsfoot trefoil, grow satisfactorily when the root barrier is close to the surface; alfalfa does not.

Slope

The degree of slope is of extreme importance in determining the intensity of cropping that may be practiced without an unacceptable rate of erosion. As the steepness of slope increases, the proportion of hayland should increase and the acreage of corn and small grains should decrease. Perennial legumes, such as alfalfa and birdsfoot trefoil, with an appropriate grass, are good on steep slopes that should be left in long-term hay.

Contour farming, diversion terraces, and breaking long slopes into contour strips make it feasible to follow a rotation system on land that would otherwise be too steep to use safely for row crops.

The degree of slope is very important in determining whether modern farm machinery can be used safely. Tractors, forage harvesters, field balers and combines, cannot be used safely on many of the steeper slopes where horses worked in earlier days.

Texture

Soil texture refers to the size of the soil particles, such as gravel, sand, silt and clay. Texture influences drainage, ease of working, droughtiness, and capacity to hold plant nutrients and water.

Sandy soils are often well drained, dry out early, and easy to work, but they may be droughty. Best management calls for very early planting to have the crop well advanced before hot and dry weather in the summer. Deep-rooted, drought-resistant legumes, such as alfalfa, and orchardgrass and smooth bromegrass are preferred. These soils are poor for permanent pasture plants with shallow roots like wild white clover and Kentucky bluegrass. Light textured soils generally respond well to fertilizer during the period when moisture is adequate. They should be fertilized liberally and frequently. In general, on coarse textured soils, it is particularly important to remove the first hay growth early so as to harvest forage of high quality and to conserve the moisture for second growth or aftermath.

Silt loams, more than other soils, have a desirable combination of good drainage, ease of working, moisture holding capacity and nutrient supplying power. Where drainage is not impeded by hardpan or affected by seepage from adjacent higher ground, silt loams are responsive to fertilizers and suited to a wide range of cropping systems, consistent with degree of slope and stoniness. Silty clay loam and clay soils have clayey subsoils and are naturally higher in fertility than the coarser textured soils; but plowing, working, planting, cultivating and harvesting on time are frequent problems. Here the proportion of hay lands should increase and the acreage of grains and corn decrease. In general, soils that are high in clay content have drainage and tilth problems and should be farmed extensively to take advantage of the natural fertility of the soil and to minimize the problems associated with plowing and working. Fall plowing is encouraged on these soils because weathering during fall, winter, and spring mellows the furrow slice and makes it easier to work in the spring.

SOIL FERTILITY AND FERTILIZATION

Acidity, pH and Liming

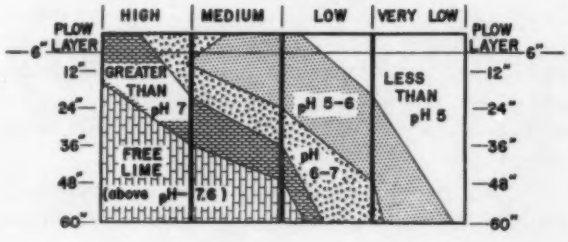
Soil acidity is the most frequent cause of alfalfa failure and the early running-out of many legume stands. The natural pH of the plow layer of New York soils ranges from an extreme low of 4.5 in the lower Hudson Valley to a high of 7.4 in central Cayuga County and in northern Franklin County. The pH of the subsoil and other lower soil layers also varies considerably; the subsoil pH is usually higher than that of the plow layer unless the plow layer has been limed.

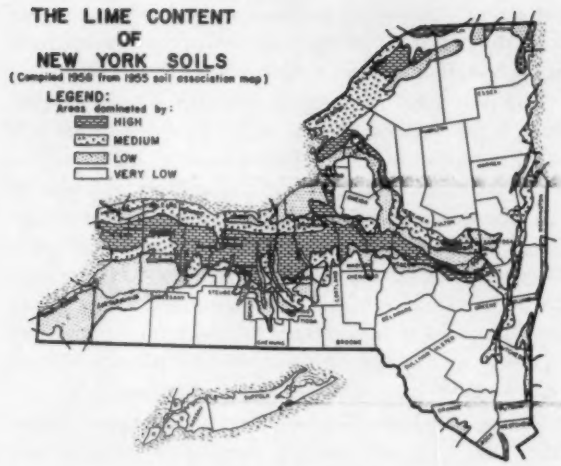
The map on page 11 shows the areas in New York State that are dominated by very low-, low-, medium- or high-lime content soils. The soil lime level diagram shows the usual ranges of pH, down to five feet, of soils of the four lime levels. The more acid the soil is naturally, the more essential it is that adequate amounts of lime, as well as fertilizer, be applied for profitable crop yields. Farmers are urged to know the lime content of the soils in their own area, to use pH tests, and to use enough lime to get big crop yields.

To take full advantage of high-yielding alfalfas, the pH of the plow layer should be maintained at about 6.8. Birdsfoot trefoil may grow on acid soils but for top yields the pH can be only slightly below that needed for alfalfa.

New York soils differ in the supply of important fertilizer nutrients for forage crops. There are three important things to remember when fertilizing.

SOIL LIME LEVEL





1. The three major *nutrients, nitrogen, phosphorus,* and *potassium,* differ with respect to their best time and method of application. (Thus, the best time to apply one may not be best for another.)
2. *Economic* as well as *agronomic* factors must be considered in determining the optimum timing and rates of fertilization.
3. The aim to fertilize for the *crop* and not just to build up the soil. See current issue of *Cornell Recommends for Field Crops.*

Nitrogen

Nitrogen is the most soluble and easily leached of the three major elements. It is readily taken up by plants and amounts consumed are sometimes greater than the plants need for optimum growth. This is called luxury consumption. Therefore, nitrogen is usually applied as the plants need it.

In most fertilized soils there is only a small amount of nitrogen in an available form at any one time; most of it is in unusable organic compounds. This element is changed to available forms as the organic matter decays. Consequently, during the summer growing season, a large amount of available nitrogen is released from soil organic matter, plant residues, and animal manures.

For non-legume hay crops, nitrogen is generally applied in *split* applications, about 50 pounds of nitrogen per application. Best responses will be obtained by making the first nitrogen application early in the spring when soil moisture and other growing conditions are best. Additional nitrogen after the first cutting may be profitable if there is adequate soil moisture. Orchardgrass is more responsive than bromegrass, timothy or bluegrass.

Phosphorus

Phosphorus is the least soluble of the three major elements. Most of the phosphorus in soils is unavailable in the organic matter, or in insoluble mineral forms such as iron and aluminum phosphates.

Even when phosphorus is applied in highly soluble forms, it is soon tied up by many compounds in the soil and made at least temporarily unavailable. This fixation of the phosphorus is more serious on acid soils high in iron, and least serious on very sandy soils and on well-limed soils. It occurs to some extent on almost all soils, however, regardless of pH and texture.

All New York soils are naturally rather low in phosphorus. There are great differences, however, in the amounts of phosphorus that have been applied to fields in fertilizers. Because phosphorus leaches very little, some farmers have accumulated good reserves of phosphorus in 10 to 15 percent of their fields through fertilizer applied to crops and through superphosphate applied with manure. Careful soil tests are helpful in evaluating the general phosphorus status.

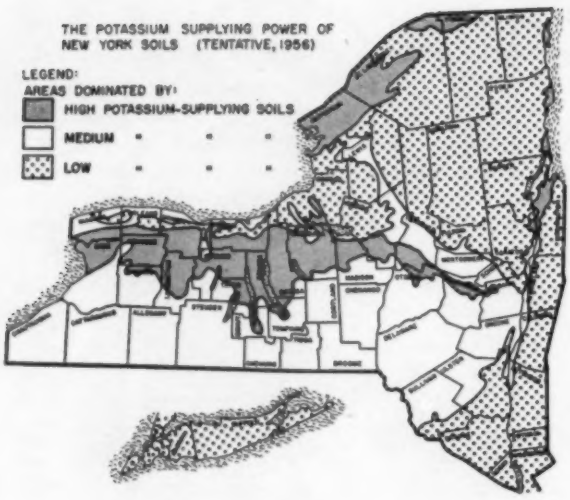
Small localized applications of phosphorus are frequently as effective as much larger applications, especially if the latter are not placed in a localized band. Band placement gives rapid early growth before the plant root systems are large enough to exploit the soil. It is especially helpful in the establishment of legume seedings.

Well established forage crops, on the other hand, are able to exploit the soil for much of their needed phosphorus. In this way they make use of phosphorus which was applied in previous seasons, or earlier in a given season. Thus, for hay and pastures, annual or biennial additions of phosphorus seem to be as effective as do more frequent applications. However, *regular* additions of phosphorus made at least every other year are preferred over larger, less frequent applications.

Potassium

New York soils differ greatly in their ability to supply potassium year after year to deep rooted forage crops. Low potassium supplying soils can supply enough potash to grow about ½ ton of legume-grass hay per acre per year; medium soils enough for 1¼ tons, and high supplying soils enough for 2 to perhaps 3 tons of legume-grass hay. For yields larger than these, extra potash must come from added manure and fertilizer. Fertilizer recommendations for forage crops are keyed to potash supplying power of soils.

Potassium is intermediate between nitrogen and phosphorus in its susceptibility to leaching. Crop removal of potassium is often as great as that of nitrogen



and is usually double or triple that of phosphorus. Potassium also is subject to luxury consumption—plants sometimes consume more than is needed for optimum growth. In general, legumes are not able to compete with non-legumes for needed potassium. This may account for legume thinning where inadequate potassium has been applied.

Because of luxury consumption, forage crops use potassium most efficiently if the plants are spoon-fed; i.e., if potassium is applied several times during the season. Such a practice would be agronomically sound. However, we must consider not only the cost of making several applications, but the competition of other farm operations for the farmers' time.

Considering all the factors involved, applications of potassium after the first cutting seem to be best. At this time of year the soil is dry enough to allow equipment to travel over the fields. In some cases the fertilizer can be custom-spread. In cases where the potassium requirement is high, a second application in the fall will often help prevent winterkilling of the legume. Three or four cuttings of the new higher yielding alfalfa varieties may well result in greater demands for potassium and the need for more than one application a year. When soil tests show a low level of potassium in a good field of legume forage, an application in early spring may be preferred to delaying fertilization until after the first cutting.

LAND USE

The most desirable land use for a farm or field is influenced by elevation, latitude, ease of working, and susceptibility to erosion. Fields that are steep and erosive must not be used heavily for row crops or in any system that frequently leaves them bare and exposed, even though the soil drainage and other characteristics are well adapted to such cropping.

Intensive land use implies planting a high proportion of the acreage to row or grain crops and a low proportion to hay crops. This means a short rotation or in extreme cases the same row crop on a field for several years. This is illustrated by the planting of corn for several successive years on the level fields adjacent to buildings on hill-valley farms. It may help to clarify the interplay of economic and physical factors by stating that economic factors influence the best land use within the limits set by the physical factors such as elevation, drainage, slope, and stoniness.

Where there are few soil and topographic limitations, the most economical pattern of farming and cropping tends to be intensive, with emphasis on short rotations. The acreage of row and grain crops tends to be large. Cash crops may be common. Legumes and grasses for forage are cut early and frequently to produce high yields of good quality in a short (one to three year) stand.

Where there are major physical limitations, a more extensive system is likely to be followed. Plowing and other tillage operations are held to a minimum. The emphasis is on longer rotations with perennial legumes. A livestock system of farming is more likely than a cash crop system.

CROPPING SYSTEMS

In choosing the best cropping system, a farmer must consider what crops can be grown, and which of these crops would be most profitable. In terms of its place in the farming system, each crop competes with other crops on the farm and with crops that may be grown in other areas.

Sound decisions on the best cropping systems require a thorough understanding of soils and soil management, sustained crop yields, seasonal labor demands, machinery and power requirements, storage facilities, utilization of feeds by livestock, and the many economic factors that affect all of these. The best combinations for a farm must be selected by the farmer himself.

The economics of different cropping systems are constantly changing because of research and new technology. For example, the development of productive earlier corn hybrids improved the competitive position of corn in relation to hay crops in short season areas. More recently, the introduction of Narragansett, a widely adapted, high yielding, vigorous alfalfa, Viking birdsfoot trefoil and other improved forage vari-

eties has tended to restore the earlier balance between corn and hay.

The best cropping system for a farm is based on answers to the following questions.

What crops can be grown? The answer to this question involves an understanding of the soil and climatic requirements of crops. Information on climate and soils was presented earlier in this bulletin and additional information for specific legumes and grasses, with their varieties, is presented later. Besides considering crops that are suited to the climate and soil, it is important to select a cropping system that will not lead to unacceptable erosion losses.

What crop yields may be expected when good practices are followed? This question is of prime importance but is difficult to answer. The farmer's first thought may be to look at the yields of the different crops on his own farm. This would be a reliable source of information if the farmer knew that he was planting the very best variety or mixture, liming and fertilizing each crop in the ideal way, performing all operations on time, following only the best supporting practices, and finally if he knew how to compare fairly the feeding value of grain, hay and silage.

The data in table 1 are from the Farm Business Chart, prepared by the Department of Agricultural Economics of Cornell, February, 1960, presents realistic yields based on a study of thousands of farm records plus the consensus of opinion of many Cornell professors on yields that are being obtained by farmers as they currently apply combinations of management practices to their fields. Yields are presented for the top 10 percent, the 50 to 60 percent, and the low 10 percent groups. These yields represent farms all over the State.

Table 1. Hay, silage and grain yields per acre on New York farms.

Group of Farms	Tons of Hay	Tons of Grass Silage	Tons of Corn Silage	Bu. of Shelled Corn	Bu. of Oats	Bu. of Wheat
Top 10%	3.5	11.0	16	95	80	50
50–60%	2.1	6.5	11	55	54	34
Low 10%	1.2	3.5	5	25	28	20

What will nutrients cost to grow or to purchase? The cost to grow livestock feed will vary from farm to farm and from year to year. Data from farm cost account records accumulated by the Department of Agricultural Economics show that forage has been the lowest cost source of nutrients throughout the period covered. Far greater improvements have been made in the efficiency of producing other crops, especially grain corn, than in growing hay.

KINDS AND VARIETIES OF FORAGE CROPS

A. A. JOHNSON

MIXTURES FOR WELL-DRAINED SOILS

Comparison of alfalfa, birdsfoot trefoil and red clover

On well-drained soils, the highest yields and best seasonal distribution of forage production is obtained with a mixture of a recommended alfalfa and grass (table 1). The mixture of Narragansett alfalfa and bromegrass produced more hay in the first harvest year than the red clover and timothy mixture, and a high level of production for the alfalfa mixture was maintained under two-cutting management through six harvest years. Production was well distributed between the first and second cuttings.

Red clover and timothy produced a good yield of hay the first harvest year and in the first cutting of the second year, although somewhat less than Narragansett alfalfa and bromegrass. By the end of the second year, the biennial red clover was dead and the accumulated nitrogen from the red clover had been used by the timothy. In the third through sixth years, the yield was poor and production was largely limited to the first cutting. Timothy is a cool weather grass and in these plots nitrogen was not applied; hence, only 0.2 tons per acre (eight percent of the season's total) was produced as summer aftermath.

In the first harvest year, the Viking birdsfoot trefoil and timothy mixture was lower in yield than either the alfalfa or the red clover mixtures. After the first year the birdsfoot trefoil mixture was higher in yield than red clover and timothy, though lower than the Narragansett alfalfa.

Cornell variety trial yields reported in this bulletin represent total dry matter recovery without the losses farmers usually encounter in forage production.

Managing alfalfa on well-drained soils

For most efficient roughage production, alfalfa on well-drained soils should be managed under a three-cutting to four-cutting rather than a two-cutting management system. This results in highest yields and the best forage quality, with production well distributed throughout the growing season. This is true for any of the recommended alfalfa varieties. Three-cutting management is best for most of the State and four cuts per year are suited to only the most favored long season areas.

The data in table 2 show typical alfalfa response to two-, three- and four-cutting management under favorable alfalfa conditions. In this trial, DuPuits produced 20 percent more hay at three cuts than at two

Table 1. **Average hay yields in tons per acre by cuttings and seasonal distribution for hay mixtures from two test plots.**

Plots located on well-drained soil limed to pH 6.5. Top dressed with P_2O_5 and K_2O each year after first cutting was removed. Management: two-cuttings per year.

	Narragansett Alfalfa and Smooth Bromegrass			Viking Birdsfoot Trefoil and Timothy			Red Clover and Timothy		
	1st cut tons per acre	2nd cut tons per acre	Total tons per acre	1st cut tons per acre	2nd cut tons per acre	Total tons per acre	1st cut tons per acre	2nd cut tons per acre	Total tons per acre
1st harvest year	3.1	1.7	*4.8*	2.6	1.2	*3.8*	2.7	1.9	*4.7*
2nd harvest year	3.2	2.0	*5.2*	2.7	1.4	*4.2*	2.8	0.9	*3.6*
Average 3rd–6th harvest years	3.4	1.7	*5.0*	3.3	1.2	*4.5*	2.4	0.2	*2.6*
Average six harvest years	3.3	1.7	*5.0*	3.1	1.2	*4.3*	2.5	0.6	*3.1*
Percent of the total	66.0	34.0		72.0	28.0		80.6	19.4	

Table 2. **Yield of hay per acre as a three year average in tons per acre under two-, three-, and four-cutting management.**

Plot located on well-drained soil, limed to pH 6.5. Top dressed with P_2O_5 and K_2O each year after first cutting was removed. Average harvest dates for each cutting for the three years are indicated.

Number of cuts per year	June			July		August		September	October	Total yield tons per acre
	2	10	25	2	22	12	19	10	12	
DUPUITS										
2 cuts, Tons/A			2.8				1.6			4.4
3 cuts, Tons/A		2.3			1.6			1.4		5.3
4 cuts, Tons/A	1.6			1.1		1.1			1.1	5.0
NARRAGANSETT										
2 cuts, Tons/A			2.7				1.5			4.1
3 cuts, Tons/A		2.0			1.4			1.2		4.6
4 cuts, Tons/A	1.5			1.1		1.1			0.9	4.6

cuts and 14 percent more at four cuts than at two cuts. Narragansett produced 12 percent more at both three cuts and four cuts than at two cuts.

Because alfalfa under the three- and four-cutting system was in early bloom to bud stage when harvested, the quality of hay was much higher than under two-cutting management where it was usually in full bloom stage. (Note in table 2 that first-cut yield increased as harvest was delayed from early to late June.) During this period digestibility dropped about one-half percent per day, resulting in loss of quality. Early June harvest of the first cutting stepped up the total yield because moisture was conserved for alfalfa growth in the second cutting and the alfalfa was at all times actively growing with little or no loss of leaves. Furthermore, early first cutting allows two or more subsequent harvests during the more favorable hay making weather of July, August and early September.

The great versatility of alfalfa is demonstrated in table 2. By using a combination of different varieties and managements, alfalfa is well suited to zero grazing, grass silage, hay, season-long rotation grazing and aftermath grazing. Under a system utilizing both three cuttings and four cuttings and several varieties on different fields, a harvest can be made about every 15 to 20 days over a period from very early June to early September, with an additional harvest about mid-October. By careful planning, it would be possible to harvest alfalfa almost every day from late May to September, yielding at each harvest from three-quarters to two tons per acre.

Under two-cutting management, especially on productive alfalfa stands, it is seldom possible to harvest hay of high quality in the first cutting because of over-maturity, heavy lodged growth, loss of leaves, and coarseness. This is a problem with all varieties, but is particularly acute with DuPuits.

Intensive three-cutting or four-cutting management of alfalfa results in more rapid stand depletion than two-cutting management. Experience in several Cornell trials proves that under a three-cutting system, farmers can expect good productive stands to remain through three to four harvest years. Wilt, when present, depletes stands of susceptible varieties although other factors, not yet understood, are more important than wilt. Under three-cutting management, fully as much forage is harvested in three years as is harvested under a two-cutting management in four years. Because of earlier harvest, the quality of roughage is much higher.

It is assumed by many farmers that the most desirable type of alfalfa management is one that maintains a good stand for a maximum number of years. Admittedly, on fields subject to erosion or otherwise difficult to plow, there are situations where maintenance of alfalfa stands for as many years as possible is desirable. However, experiments conducted by Cornell prove that management for a long-lived stand usually requires two-cutting management which, contrasted to three to four cuttings, results in reduced yields and forage of lower quality.

Under favorable conditions for alfalfa, good productive stands have been maintained in Cornell trials for eight years. In one such trial on gravelly soil, well-limed and fertilized two-cutting management was used. This permitted the alfalfa to come into full bloom at

almost every harvest. No cuttings were made in September or October. As an annual average for the eight years, a yield of 4.2 tons per acre was harvested from Ranger. By the fall of the eighth year, Ranger had a stand of 45 percent that was still producing about three tons per acre. Under similar situations in other trials, Vernal has been higher yielding and more persistent than Ranger.

Legume—grass mixtures for rotational or zero grazing

Alfalfa and bromegrass or orchardgrass is a productive mixture on well-drained soils for rotational and zero grazing or for grass silage followed by rotational grazing. Data in table 3 compare several mixtures cut four times during the season. The highest yield and the most favorable forage distribution throughout the season was obtained from mixtures with alfalfa. By removing the first cutting between late May and early June, excellent distribution of high quality roughage production resulted. Under these conditions, which were very favorable for alfalfa, mixtures of Viking or Empire birdsfoot trefoil were less productive.

Cornell trials demonstrate that Ladino clover is short-lived and lacks drought resistance when it is the only legume in a mixture. Ladino generally produces satisfactorily during the first harvest year, but usually survives only one to two years. Summer production is especially low during droughty periods. Ladino is a desirable component in a pasture mixture that contains alfalfa and a grass.

Table 3. **Seasonal distribution of forage production under four-cutting management.**

Three year average well-drained loam soil

Mixture	Production in tons per acre				
	May to Early June	June to Early July	July to Early August	August	Season Total
Narragansett alfalfa, Ladino clover and orchardgrass	1.9	1.1	0.7	1.3	5.0
Narragansett alfalfa, Ladino clover and Saratoga smooth bromegrass	1.9	1.2	0.8	1.3	5.2
Viking birdsfoot trefoil and timothy	1.4	1.1	0.4	1.0	3.9
Empire birdsfoot trefoil and timothy	1.3	0.9	0.2	1.0	3.4

An alfalfa-grass mixture provides lush aftermath for rotational grazing.

MIXTURES FOR MODERATE TO SOMEWHAT POORLY-DRAINED SOILS

Alfalfa

Until recently, most farmers believed that soils of moderate to somewhat poor drainage were unsuited to alfalfa culture. This belief was borne out in Cornell trials and county extension demonstrations, but is true only with the alfalfa varieties and seed sources and production practices in common use 15 years ago; these same trials and demonstrations plus farm experience now prove that by use of the new varieties with adequate lime and fertilizer, alfalfa does contribute to efficient forage production on soils with drainage problems.

Results of hay management trials are reported in table 4. These trials were harvested for a three year period. The soil was limed to a pH of approximately 6.5 prior to seeding. Each year after the first cutting, P_2O_5 and K_2O were applied. These trials, representative of several others also located on typical dairy farms, clearly demonstrated that alfalfa, particularly the Narragansett variety, can be grown successfully on soils of moderate to somewhat poor drainage, provided enough lime and plant nutrients are added. It is also demonstrated that over a three-year period, Narragansett alfalfa and a grass is superior in yield to red clover and timothy. A satisfactory yield for the first harvest year is characteristic of red clover after which the hay yields drop off rapidly because of red clover's biennial nature.

The DuPuits variety also has been tested on soils of somewhat poor to moderate drainage. High seedling vigor often gives this variety a good initial stand, and

Table 4. **Average hay yields and percent legume stand from test plots conducted in North Country Counties.**

Alfalfa and birdsfoot trefoil planted with several timothy and smooth bromegrass varieties. Soil of moderate drainage.

Mixture	Tons of hay per acre				Percent legume stand (fall of harvest year)		
	1st yr.	2nd yr.	3rd yr.	3 yr. ave.	1st	2nd	3rd
Narragansett alfalfa with grass	3.9	3.9	2.8	3.6	75	28	12
Ranger alfalfa with grass	3.4	3.3	2.4	3.0	72	19	4
Empire birdsfoot trefoil and grass	3.4	2.9	2.7	3.0	53	44	49
Viking birdsfoot trefoil and grass	3.5	3.4	2.9	3.3	57	46	47
Medium red clover and timothy	3.8	2.9	1.7	2.8	83	1	2

yield from trial plots over a two-year period are about equal to Narragansett. In these trials, however, and in county extension demonstration plots, DuPuits has been much less persistent than Narragansett. Furthermore, at high elevations and on soils of somewhat poor to moderate drainage, it is difficult to make the required timely and frequent harvests for a fast growing variety such as DuPuits.

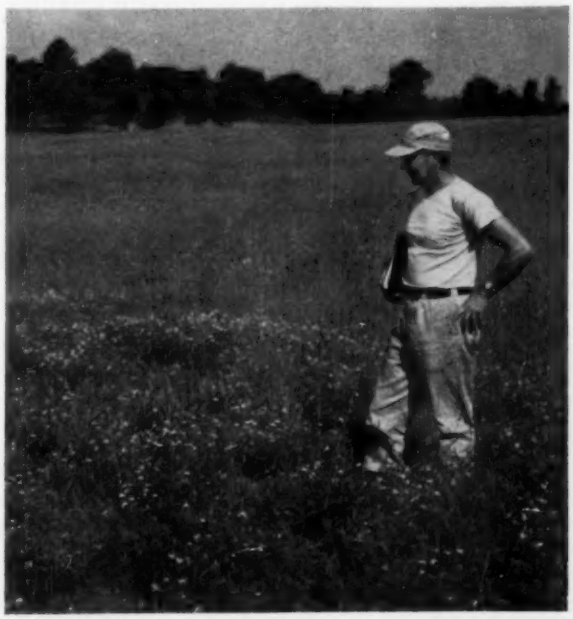
Lack of persistence of alfalfa stands beyond three to four harvest years is characteristic on soils of somewhat poor to moderate drainage (Note in table 4 the loss in alfalfa stands in the second and third years). If good initial stands are established and proper management is practiced, however, a high yield of three to five tons of hay can be harvested for a three- and sometimes four-year period. A vigorous 50 percent but thinning, well-fertilized stand of a two to three year old alfalfa and grass produces a very satisfactory yield.

As an average for three trials conducted on farms in the North Country and the Southern Tier counties, on soils ranging from moderate to somewhat poor in drainage, the legume portion of the hay produced on the Narragansett plots dropped from 68 percent in the second harvest year to 63 percent in the third year, and to 33 percent in the fourth year. Yields fell from a high of 4.7 tons per acre in the second year to three tons per acre in the fourth year. Narragansett, being the most persistent alfalfa variety on such plots, suffered less than other alfalfas. After the alfalfa is badly depleted to a 25 or 30 percent stand, hay yields drop off rapidly. If the bromegrass or timothy stand is good, however, high yields can be maintained for several additional years with nitrogen top dressing. On soils of moderate drainage, and more sloping somewhat poor drainage, alfalfa should normally be managed under a two-cutting system because of the shorter effective growing season, and the increased tendency of alfalfa to heave and winterkill on such soils.

Unfortunately, because of alfalfa's premier position as a forage, it is sometimes planted on soils that are too poorly drained for alfalfa to persist, as well as on soils that have not been adequately limed.

Birdsfoot trefoil

Birdsfoot trefoil is well adapted to soils where internal drainage is a problem. If birdsfoot is the only legume in the seeding mixture, yields are usually somewhat lower during the first harvest year than are mixtures made up with alfalfa or red clover. Inasmuch as established birdsfoot trefoil stands last longer than do stands of biennial red clover, and because they usually persist better than alfalfa, this discrepancy is equalized by the end of the second or third harvest year. Nevertheless, there is frequently some loss of stand in birdsfoot trefoil plots. Methods whereby birdsfoot trefoil stands can be maintained indefinitely are not well understood. Yet excellent farm stands of the Empire variety have been maintained for more than 20 years.



A productive stand of Empire birdsfoot trefoil, more than twenty years old, on heavy soil in Albany County.

Under such situations there is considerable seed shattering and reseeding which is often not the case under hay management. Several Cornell tests, particularly those conducted in the North Country, have demonstrated the superior persistence of Empire birdsfoot trefoil as contrasted to Viking or European birdsfoot trefoil or the alfalfa varieties.

Two distinct types of birdsfoot trefoil are in wide use on New York dairy farms. The Viking and Mansfield varieties and European seed sources are upright in growth habit and bloom at about the same time as red clover and the standard alfalfa varieties. They are well suited to first-cut hay or silage and aftermath grazing or two hay cuts, and may be grown as the only legume in the mixture or with a recommended alfalfa variety. Empire blooms 10 to 14 days later than Viking. It is also more prostrate and slower in stand establishment and early spring growth; Empire should not be grown in mixture with alfalfa or red clover. Empire stands are more persistent than other birdsfoot varieties, particularly on soils of poor drainage. Empire is finding increasing use as a late-hay variety with Climax timothy plus aftermath grazing, or as straight grazing. In the years ahead, the late blooming Essex timothy will find increasing use as a companion grass with Empire.

Red clover

The acreage planted to red clover and mixtures of red clover for hay purposes has been steadily declining in the State during the past eight years. During this period there has been a striking increase in acreages planted to alfalfa and birdsfoot trefoil. Red clover is used for hay purposes on a wide range of soil conditions, ranging from poorly to well drained, and usually where the pH is 6.0 or below. Its greatest use should be on poorly drained soils not suited to alfalfa and where farmers have not successfully established birdsfoot stands. Because of its biennial nature, it is capable of producing good yields of hay for only one harvest year and for the first cut of the second harvest year. It is usually sown in mixture with timothy. If the stands of timothy are good, high yields can be maintained with nitrogen top dressing after the red clover has died.

A large number of county extension forage demonstration plots and farm experiences prove that seeding a mixture of alfalfa and red clover is a poor farm practice. Adding red clover to the mixture sometimes adds tonnage in the first harvest year. The red clover is, however, very competitive with alfalfa. This often results in a badly depleted stand of alfalfa after the short-lived red clover has died.

Alfalfa and birdsfoot trefoil mixtures

On fields with spotty drainage conditions, Cornell test plots and farm experience have repeatedly demonstrated the superior stand establishment and high yield capability of a mixture of Narragansett alfalfa and Viking birdsfoot trefoil with a grass such as Climax timothy. This is contrasted to either Narragansett or Viking alone with timothy. This mixture has been superior in yield to Empire birdsfoot trefoil and timothy.

Data in table 5 illustrate the very high yield potential of the mixtures of Narragansett alfalfa, Viking birdsfoot trefoil and Climax timothy on soils of moderate to somewhat poor drainage. Even in the first year, this mixture was higher in yield than mixtures with red clover used in place of Viking birdsfoot trefoil. Data in these trials are typical of the performance of this mixture in other Cornell trials, and are supported by a large number of county extension demonstration plots and farm experience.

Farmers can expect to harvest the high yields reported for alfalfa and birdsfoot mixtures only where a good stand is established, the soil is limed to a pH of 6.5 or higher, and adequate amounts of plant nutrients are applied.

In the mixture composed of Narragansett, Viking, and Climax, situations that favor alfalfa, such as the well-drained or moderately drained spots in a field, have a stand which is predominantly alfalfa. Other spots, more poorly drained or deficient in lime, tend to have a stand with Viking birdsfoot trefoil predominating.

Cornell research and county extension forage variety demonstration plots have repeatedly revealed that on

Table 5. **Three year average yield of hay from three trials at high elevations in the Southern Tier and North Country Counties.**

Soil of moderate to somewhat poor drainage.

Mixture	Tons of hay per acre			
	1st year	2nd year	3rd year	3 year average
Narragansett and Climax	2 8	4.7	3.8	3.8
Narragansett, red clover and Climax	2.8	4.9	4.0	3.9
Empire and Climax	2.5	3.6	3.4	3.1
Viking and Climax	2.9	4.0	3.9	3.6
Narragansett, Viking and Climax	3.3	5.3	4.5	4.4

soils of moderate to somewhat poor drainage, the alfalfa and birdsfoot trefoil mixture has a stand of perennial legumes that is superior to any other mixture. This mixture is especially desirable for fields of variable drainage. Alfalfa and birdsfoot trefoil are compatible in a mixture; red clover and alfalfa or red clover and birdsfoot are not compatible.

GRASS ALONE OR GRASS-LEGUME MIXTURES

Acid soils, which have not been considered sufficiently well drained to grow alfalfa successfully, are widespread in New York State. The preponderance of such soils has resulted in heavy reliance on grass, particularly timothy, for forage production. Until recent years, red clover, which is widely adapted though short-lived, has been the principal legume component of such seeding mixtures. As stated elsewhere in this bulletin, alfalfa and birdsfoot is now successfully planted on soils of moderate to somewhat poor drainage. Grass, primarily timothy and bromegrass, will remain very important components in forage mixtures, however. Therefore it is desirable to understand the potentials and limitations of grasses.

Comparative costs

With nitrogen fertilizer becoming increasingly abundant and lower in price, the question is raised whether grass plus nitrogen may be more economical than legumes under some conditions. Here is a rough comparison of costs for the two systems. Recommended fertilizer for grass meadows is 50 pounds each of nitrogen, P_2O_5 and K_2O in one year and 50 pounds of nitrogen in the next year. At 1959 prices, the average yearly cost would be about $11.50 per acre.

The forage program based on legumes requires more lime and potassium fertilizer. For an average silt loam with a soil pH of 5.2, an initial application of 1½ tons more limestone than for a grass program, plus 20 percent higher annual maintenance costs, about $1.20 per acre per year over a 20-year period. Annual topdressing with 60 pounds each of P_2O_5 and K_2O costs about $8.00. Combined charge for lime and fertilizer is $9.20 which is slightly below the charge for grass plus nitrogen.

A modified legume-grass program would involve liming and fertilizing to establish good stands of alfalfa and/or birdsfoot trefoil with timothy. As the legume disappears, nitrogen could be applied to the predominantly grass sod to maintain high yields. Straight grass is more responsive to nitrogen applications on soils limed to correct acidity.

The legume program will require plowing and reseeding more often. Whether this is an important disadvantage depends upon the expected yields of the corn and oat crop that are planted preparatory to reseeding the legume.

Limitations of relying on straight grass

Reliance on grass, either timothy or smooth bromegrass as the principal source of forage, has several serious disadvantages for dairy farmers. This is particularly true if the first harvest is delayed, in which case nearly all of the forage (75 percent to 80 percent) is harvested in the first cutting. This results in a high peak in demand for labor and machinery to harvest hay while weather conditions are frequently unfavorable; inefficient use of the costly items of farm expense—labor and machinery; and lower yield because land is utilized for growing the crop during only a portion of the growing season.

Meadows composed of a mixture of a perennial drought resistant legume such as birdsfoot trefoil or alfalfa and grass produce a higher yield than does grass alone; provide well distributed production throughout the growing season; and a portion of the forages is harvested during the summer months, July and August, when harvest weather is more apt to be favorable.

Timothy alone and in legume mixture

The performance on well-drained soils of seedings made up of timothy alone, timothy with European and with Empire birdsfoot trefoil, and timothy with alfalfa is reported in table 6. In each case, timothy data rep-

Table 6. **Acre yield (four year average) of timothy alone, timothy with European and Empire birdsfoot trefoil, and timothy with Ranger alfalfa. Well-drained soil. Timothy data represent an average for seven varieties. Timothy plots top dressed with 30 pounds of nitrogen in the spring and after the first cutting (60 pounds total).**

Entire plot top dressed each year with P_2O_5 and K_2O.

Seeding	Tons per Acre—Four Year Average			Percent Grass	
	1st cut	2nd cut	Total	1st cut	2nd cut
Timothy alone	3.6	0.9	4.5	100	100
Timothy and European birdsfoot trefoil	3.1	1.3	4.4	81	45
Timothy and Empire birdsfoot trefoil	3.0	0.8	3.8	68	46
Timothy and Ranger alfalfa	3.2	1.3	4.5	78	32

resent an average of seven varieties. In this test, all timothy-alone plots were top dressed with 60 pounds of nitrogen per year, 30 pounds in the spring and 30 pounds after the first cutting. Well-fertilized timothy produced an average of 4.5 tons per acre with 80 percent of the season's total in the first cutting. This was the same total yield as the alfalfa and European trefoil when each was grown with timothy. Here about 70 percent of the total was in the first cutting and 30 percent (1.3 tons per acre) was aftermath.

Under conventional two-cutting management, it is clear that farmers relying on timothy for hay must meet nearly all of their hay needs for the year at the first cutting. This is a very difficult task for the 10 to 14 day period available in June for making early-cut, high quality hay.

In the mixture with each of the three legumes, timothy contributed the greater share of the hay in the first cutting. In the second cutting, particularly with alfalfa, timothy contributed a smaller part (32 percent of the total).

Summer or second-cutting production of timothy alone varied greatly from season to season. The range was from a low of 0.4 tons per acre in a dry, warm summer to a high of 1.8 tons in a cool, moist summer. The alfalfa and timothy mixture had a much smaller range, from a low of 1.1 tons per acre to a high of 1.5 tons per acre.

Smooth bromegrass alone and in legume mixture

The contrast between total, as well as aftermath, production of a mixture composed of alfalfa and smooth bromegrass as contrasted to bromegrass alone and timothy alone, is demonstrated in a Cornell trial conducted on well-drained soil. Over a four year period, the alfalfa and bromegrass mixture produced 4.6 tons per acre, Lincoln bromegrass produced 2.7 tons, and timothy, 2.3 tons. The bromegrass and timothy were not top dressed with nitrogen. About 90 percent of the season's total forage output in bromegrass and timothy was produced as the first cutting with very little aftermath. As a contrast, about two-thirds of the total season's output in the alfalfa and bromegrass mixture was harvested in the first cutting and one-third in the second cutting.

Smooth bromegrass alone and bromegrass with Narragansett alfalfa and Ladino have been compared under four-cutting management. Nitrogen was applied to the bromegrass at rates of 30 pounds in the spring and 30 pounds after each harvest for a total of 120 pounds per acre per year. Results are reported in table 7. Yields represent a three year average.

Table 7. **Three year average yield from smooth bromegrass alone and smooth bromegrass in mixture with Narragansett alfalfa and Ladino clover—22 different seed lots of smooth bromegrass. 120 pounds of nitrogen added to bromegrass—alone plots each year—30 pounds in the spring and 30 pounds after each cutting is removed. Both mixtures top dressed with P_2O_5 and K_2O after first cutting is removed.**

Well-drained soil, limed to pH 6.5.

Cutting dates (approximate)		Three Year Average				
		5/25	6/29	8/6	9/20	Total
Smooth bromegrass	T/A	1.8	0.5	0.5	0.7	3.5
Percent Total		51.4	14.3	14.3	20.0	
Smooth bromegrass with Narragansett alfalfa and Ladino clover	T/A	1.8	0.9	0.9	0.8	4.3
Percent Total		41.8	20.9	20.9	18.6	

The smooth bromegrass alone produced a forage yield by late May that was equal to the bromegrass with Narragansett and Ladino. In the second and third cuttings, the smooth bromegrass fell behind in yield, although in the fourth cutting it nearly equaled the alfalfa mixture in production during the cool, moist month of September. Total yield for well-fertilized smooth bromegrass alone was about 23 percent less than the mixture containing Narragansett alfalfa and Ladino. The cutting treatment practiced in this experiment severely reduced the smooth bromegrass stand in the alfalfa plots. Good bromegrass stands were maintained in the grass-alone plots, however.

Lack of summer moisture and high temperatures are the principal reasons for the unsatisfactory summer production of smooth bromegrass alone as contrasted to the mixture containing alfalfa and Ladino. In one droughty summer during the three-year period, the smooth bromegrass alone produced only 0.3 tons of forage for the June 29 to August 6 cutting period; in the same year the alfalfa mixture produced 1.1 tons of forage.

Other trials bear out the essential findings reported in table 7. In one trial that included several alfalfa varieties and the grasses, Saratoga bromegrass, Climax timothy, and Pennlate orchardgrass, the highest yields per acre and best seasonal distribution under three-cutting management was harvested where the mixture contained alfalfa. Under four-cutting management, the alfalfa stands were hurt somewhat and straight grass yields with 120 pounds per year of nitrogen (30 pounds in the spring and 30 pounds after each cutting) were about the same in yield as where alfalfa was included in the mixture.

Managing straight grass for high yield and quality

In situations where farmers rely on straight grass, timothy or bromegrass, for forage, the total yield plus good aftermath plus high quality can be obtained by making the first cutting by or before June 25. In a Cornell trial, making the first cutting of Saratoga bromegrass by June 23 resulted in 2.2 tons per acre, followed by 1.4 tons as aftermath, for a season total of 3.6 tons. Where the first cut was made in early July, however, 2.3 tons per acre were harvested, followed by only 0.6 tons as aftermath for a season's total of 2.9 tons. Similar results were obtained with Climax timothy. In each case, the grass was top dressed with 30 pounds of nitrogen in the spring and again after the first cutting was removed, for an annual total of 60 pounds.

Many farmers with straight grass meadows believe that highest yields result from delaying the first cutting until very late June or early July. In contradiction to this belief, several Cornell trials prove that for top yield and quality of straight grass meadows, the first cutting should be removed early—before June 25. This permits regrowth to set in before the soil moisture has been depleted.

FORAGE HARVESTING AND STORAGE

C. S. WINKELBLECH

A good combination of forage harvesting and handling equipment is an indispensable part of a modern forage program. Without adequate machines to handle and preserve the crop after it has been produced, efforts expended to grow the crop will be largely nullified. With the emphasis on heavier fertilization, improved varieties, higher yields, and earlier and more frequent cuttings, the machinery becomes even more critical. The choice is difficult to make because consideration must be given to many factors. Some of these factors—the soil type, steepness, stoniness, and in many cases the shape and location of fields—cannot be changed. Changes in storage structures and feeding practices can sometimes be made to complement a particular machinery and handling pattern. In addition to physical limitations, economic and management aspects deserve equal consideration—availability of labor at critical times, financial resources, and future plans for the farm business are a few.

Research data are available on the cost and performance characteristics of individual harvesting machines and handling equipment. These data can be used as a guide, but only the farm operator can assemble the combination that offers the best forage handling system at a reasonable cost.

TWO BASIC HARVESTING PATTERNS

The first major decision is that of selecting the basic harvesting machines, because the choice of supplemental equipment is governed largely by the form in which forage is handled.

Field choppers are owned by a small percentage of the farmers producing dry hay. Pick-up balers are by far the most popular basic harvest tools, but a growing number of larger farm operations support both a baler and field chopper. A survey[1] of 326 farms in four dairy regions of the State indicated an appreciable savings in machinery and labor cost by using a field chopper alone for harvesting hay and grass and corn silage, as compared to the use of both a baler and field chopper. Savings ranged from $3.90 per ton of hay equivalent on a 25-cow dairy to $1.70 per ton on a 65-cow dairy. However, cost alone is not the only determining factor. In order to overcome the objections usually associated with chopped hay, such as slower rate of harvest, dustiness, and difficult feeding, it is usually necessary to make changes in the storage structure and feeding procedure. More tractor power and a high capacity chopper are also required to maintain a field harvest rate comparable to the average size baler.

The use of short cubical bales with an ejector saves labor.

With the introduction of short, cubical bales, labor requirements have been reduced to equal that of a field chopper operation. Small bales are ejected mechanically from the bale chamber into a trailer wagon; from the wagon they are elevated and distributed at random in the mow. Tests show that random piled bales can be dried satisfactorily with heated or natural air. The increase in twine cost is offset by the lower labor cost formerly needed to lift and place bales.

FIELD PELLETING MACHINES

In the future, field pelleting or wafering machines may become basic hay harvesting tools in less humid

[1] L. C. Cunningham and L. S. Fife, Agricultural Economics Bulletin 933, "An Analysis of Forage Harvesting Patterns".

areas of the United States, but unless a better principle of forming the wafers is found, these machines will be of little value in overcoming harvest problems in the Northeast. Present wafering machines operate effectively in hay of 14 percent but not over 20 percent moisture. The greatest limitation in the humid regions is that of drying forage to 20 percent moisture for safe storage. Hay wafering suggests some attractive possibilities for reducing storage and handling costs at the feeding site and, therefore, developments in the machines will continue.

SUPPLEMENTAL FORAGE HARVESTING MACHINES

The day is rapidly passing when the entire forage crop is dried in the field by natural processes. Machines and equipment are available to supplement natural drying and thereby reduce field losses. The extent to which a farmer can afford to invest in this equipment can be determined only by the volume of the forage processed and the value he places upon better quality.

Hay conditioning machinery

Hay crushers and crimpers reduce the amount of field drying time 30 percent to 50 percent when they are correctly operated and when natural drying conditions are favorable. During periods of prolonged rainfall, they are of little value. The capacity of a hay conditioner is comparable to a mowing machine; therefore its use is not a bottleneck in the haying operation. In fact, a hay conditioner might increase the total seasonal harvest because of the shorter field drying time associated with its use.

Hay crushers and crimpers reduce total drying time.

The cost of owning and operating a hay crusher or crimper should range from $1.10 to $2.25 per ton, depending on the extent of use.

Natural forced air or mow dryers

Another method used to speed the rate of drying and reduce field exposure time is that of forcing natural air through partially cured hay in the mow. Hay is dried in the field to a moisture content of 35 percent to 40 percent and is then placed over a duct system through which outside air is forced by an electric motor-driven fan. In a well designed system, the average seasonal drying rate is closely related to the size of the electric motor which drives the fan. This rate is about one ton of 40 percent moist hay per day for each horsepower of the motor, but heavier loading at less frequent intervals is permissible. Because motors larger than five or 7½ horsepower are seldom permitted on single phase rural lines, the capacity of a single mow drying unit can become a bottleneck in the haying operation. Two or more systems with separate motors and fans may be required in order to have a mow drying rate equal to the field harvesting rate. Improved motor design may make it possible to use up to 20 horsepower on a single phase line but the drying rate is an important consideration that is often overlooked, particularly when new, more efficient machines of higher capacity are added to the field harvesting operations. The success of a mow drying system depends upon careful design, close attention to details in loading, and on favorable outdoor temperature and humidity conditions.

The costs[2] of a mow hay-drying unit are at present about the same as the costs of owning and operating a hay conditioner.

Heated air or batch drying systems

When the temperature of the air being forced through the hay is raised to 140 degrees F. or more, the drying rate is about double that of a natural air unit of the same size. The drying rate is nearly independent of outside temperature and humidity conditions. It is necessary to load a heated air system in batches (as distinguished from a natural air system in which succeeding layers of moist hay are placed over the system) to avoid the costly and wasteful process of over-drying hay near the duct system. Additional handlings will increase labor requirements unless specially built drying wagons are used in place of a platform.

[2]M. P. Kelsey and B. F. Stanton, "Study of the Operation of Forced Air Mow Dryers on N. Y. Farms", 1956–57.

Survey data[8] of farm installations indicate that the cost of heated air drying is approximately four times greater than the cost of using a natural air dryer.

Because of the relatively high initial investment, the equipment should be used on 200 tons or more of hay each year in order to keep the unit cost within reasonable limits. A five horsepower unit has a drying capacity of 10 to 12 tons per day. This represents less than three hours of field harvest time with a good baler. Large operations cannot operate at full capacity of field equipment when using a single drying unit unless provision is made to dry a part of the crop by some other means.

WHICH EQUIPMENT SHOULD A FARMER BUY?—WHAT ABOUT THE FUTURE?

At some point the cost of owning and operating conditioning and drying equipment of sufficient capacity exceeds the value to be derived from it. The most complicated variable in choosing a good combination of forage harvesting equipment is that of unpredictable weather. The value of early-cut forage in both yield and quality is pointed out in other parts of this bulletin. This applies to silage as well as dry hay. The ideal season for harvest is the same whether 50 tons or 500 tons are handled. As farm operations increase in size, it may become advantageous to shift from a dry-hay program to one that includes a high proportion of silage. The money normally invested in equipment to extract water from a large volume of forage can easily exceed the cost of structures and equipment for preserving moist, chopped forage. At the same time, the operator can reduce or eliminate many bottlenecks inherent in drying equipment and adverse weather.

Relatively new, large-capacity field machines will make the possibilities of high moisture storage even more attractive to large operators. Self-propelled windrowers which take a 10 to 12 foot swath of standing forage and place it in a uniform windrow are now available. This tool eliminates the need for raking and reduces the possibility of stones in the windrow. It should be well suited to a forage program that includes three or more cuttings per year.

Self-propelled and the new high capacity trailed field choppers have nearly twice the capacity of older, conventional choppers. These should further increase the rate of harvest on larger operations, particularly when ample power is available to operate them.

[8]G. J. Conneman and C. A. Bratton, "Study of the Operation of Heat Driers on New York Farms". 1957.

UTILIZATION OF FORAGES

C. M. CHANCE

It is generally recognized that high quality forage is the basis of a successful feeding program for dairy cattle and other livestock. The pay-off for a farmer's time comes at harvest and, in the case of livestock, the response of the livestock to the quality of forages provided for them. Poor harvesting management results in low quality forage and can nullify the best of the farmer's earlier efforts.

EARLY-CUT OR LATE-CUT FORAGES

Yield

Research at Cornell and other experiment stations has shown that time of cutting influences quality of forage. Some results of the Cornell research are summarized in table 1. Note that total digestible nutrients (TDN) is the same for non-legumes and legumes at a specific date. The TDN of first-growth forages declines at the rate of approximately 0.5 percent each day. The protein content of legumes is higher than that of non-legumes at all stages of growth. The protein content of forages also declines with advance in maturity. The fiber content of the forage increases as the plant matures, and is largely responsible for the reduction in TDN and palatability of the forage.

Cutting forages at an early stage of growth has been encouraged for many years. However, the yield at first cutting of forage is lower in the early season than for the same forage cut at a later date. If the forage contains considerable legumes, a high yield of second growth material may be obtained. The yield of dry matter available for cutting at different stages of growth is presented in table 2.

Table 2. **Forage available for cutting at different stages of maturity. Legume-grass mixture.**

(2 year average)*

Approximate cutting date	Method of handling	Pounds of dry matter per acre		
		first cutting	second cutting	total
June 1	Silage	2880	2235	5115
June 15	Barn-dried	4030	1815	5845
July 5	Field-cured or silage	4365	1325	5690

*Cornell University Agricultural Experiment Station Bulletin 910, 1955.

Losses of dry matter

The losses of dry matter through handling and storage vary according to the method of handling. Therefore, the amount of dry matter available for feeding becomes an important consideration in a farmer's management program. In the experiment cited in the table above, the dry matter available for feeding for barn-dried hay was 85 percent; for late silage, 84 percent; for early silage, 80 percent; and field-cured hay, 78 percent. Other experiment stations have observed similar trends in preservation of dry

Table 1. **TDN, digestible protein and total protein contents of roughages.**

(expressed on 10 percent moisture basis)*

Cutting date	Approximate stage of growth	Non-legumes			Legumes		
		TDN	Digestible protein	Total protein	TDN	Digestible protein	Total protein
		Percent	Percent	Percent	Percent	Percent	Percent
June 1	Vegetative	63	12.2	15.2	63	16.8	21.0
June 15	Bud	57	9.0	11.3	57	13.1	16.4
July 1	Bloom	50	6.0	7.5	50	9.2	11.5
July 15	Mature	44	3.3	4.1	44	5.8	7.3
Second cutting 5–9 week regrowth period		52	9.0	11.3	52	12.9	16.1

*Reid, Cornell University, Hoard's Dairymen, June, 1955.

matter with the methods mentioned here. It has been observed that wilted early-cut silage will provide as much dry matter for feeding as barn-dried hay.

Milk per acre

No appreciable differences in feeding value have been found among barn-dried hay, field-cured hay and hay-crop silage when the forages were harvested at the same time (same stage of maturity). When the forage for silage, for barn-dried hay and for field-cured hay was harvested at different dates (different stages of maturity), significant differences in milk production were obtained. The daily consumption and milk production for roughages harvested at different dates by different methods is presented in table 3. The daily roughage consumption figures indicate that intake increases with quality (early-cut forages considered to be higher quality than late-cut forages), which permits a higher percentage of nutrients to be obtained from roughage. In considering the results in the table, it must be recognized that the differences resulted from the different stages of maturity at which the forage was harvested rather than from the method of handling.

Milk per acre is the result of a high-yielding crop cut at an early stage of maturity, and preserved by a method to provide the most dry matter for feeding.

LESS GRAIN NEEDED WITH EARLY-CUT FORAGES

The major uses of feed nutrients by dairy cattle are for body maintenance, production, gain in weight, and development of the fetus. It is logical to assume that less grain would be needed when dairy cattle are fed all the early-cut forages they can consume. Also, a lower protein content grain mixture can be used. Table 4 shows the amounts of grain and percent protein of grain needed for 1200 pound cows producing 40 pounds of 3.5 percent milk and receiving roughages at the rate of two pounds hay equivalent (H.E.) per 100 pounds bodyweight. Still lower amounts of grain would be needed with the various roughages if the rate of consumption was 2½ pounds H.E. per 100 pounds bodyweight or higher. Likewise, greater amounts of grain would be needed if the cows consumed less than the two pounds H.E. per 100 pounds bodyweight indicated in the above table. Results of feeding trials indicate cows voluntarily consume larger amounts of early-cut forages than late-cut forages. Low protein home-grown grains such as corn, oats, barley and wheat could be used to formulate the dairy ration when early-cut forages are fed, particularly when cows are consuming large quantities of early-cut forages that would provide sufficient protein to meet the needs of the cow.

Table 4. **Amount of grain and protein content of grain needed with different roughages.**

(1200 pound cow producing 40 pounds 3.5 percent milk and receiving roughages at 2 pounds hay equivalent per 100 pounds bodyweight)

Stage of growth	Grain needed	Total protein in grain	
		Legumes	Non-legumes
	pounds	percent	percent
Vegetative	9.0	0	0
Bud	11.0	0	5
Bloom	13.5	4	11
Mature	15.5	10	15

ALL SILAGE, ALL HAY, OR BOTH

Hay-crop silage or corn silage can be used as the only roughage for dairy cows or heifers, but the best results are usually obtained when it is fed in combination with some hay. Unless the hay-crop silage is cut early, it is generally necessary to feed more grain than usual. If this is not done, the cows are apt to drop in milk production or to lose weight because of a smaller intake of nutrients.

Milk production of cows usually increases slightly when silage is added to a ration of good hay and grain. Studies of Dairy Herd Improvement production and

Table 3. **Daily consumption and milk production for roughages harvested at different dates or stages of maturity by different methods.***

Approximate date of cutting	Roughage	Daily feed consumption		Daily grain fed	Daily 4 percent FCM	Daily gain or loss in weight	Milk per acre	Relative milk per acre
		Actual	Dry matter					
		pounds	pounds	pounds	pounds	pounds	pounds	percent
June 1	Early silage	115.6	27.3	11.5	44.7	+.38	2621	123
June 15	Barn-dried hay	30.5	26.1	11.5	40.0	+.40	2711	127
July 5	Field-cured hay	28.6	24.4	11.5	37.6	+.17	2129	100
July 5	Late silage	87.4	24.1	11.5	38.1	−.51	2140	101

*Cornell University Agricultural Experment Station Bulletin 910, 1955.

feeding analyses indicate that herds receiving considerable quantities of silage generally attain higher levels of production than those receiving no silage.

CORN OR GRASS SILAGE

All farmers have forages that can be stored in the form of silage. Many also have land adapted to corn. This latter group often raises the question of whether to make grass silage (hay-crop silage) or corn silage or both. A good management practice would be to make grass silage from surplus grass in early spring, feed it back during the dry season and fill the silo again in the fall with corn silage.

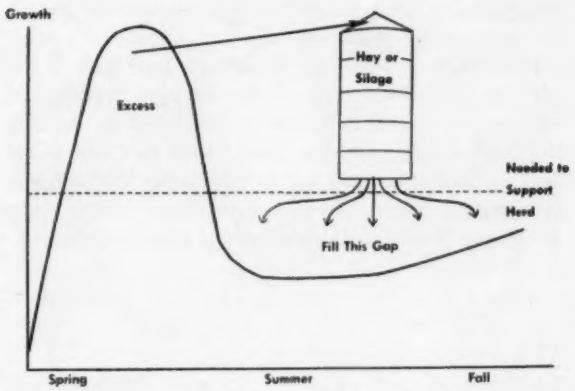
Some experiments have found grass silage to equal corn silage in value for milk production. However, most trials have shown corn silage to have the advantage which can be traced to the nutrient content of the silage. In general, hay-crop or grass silage is lower in TDN than well-eared corn silage. This is because hay-crop silage lacks the grain contained in well-eared corn silage. However, hay-crop silage is similar in TDN content to immature corn silage or corn silage with only a few ears.

In general, higher yields of TDN per acre are obtained with corn silage than with hay-crop silage. Corn silage is a combination of roughage and concentrates. Well-eared corn silage would contain one pound of dry corn grain in each seven to nine pounds of silage. Therefore, a cow eating 30 pounds of such silage a day would get three to four pounds of corn grain in the silage. Corn silage is low in protein, and supplemental protein must be provided in the grain mixture unless it is fed with an early-cut legume hay.

SUPPLEMENTAL FEEDING ON PASTURE

To have a good pasture it is necessary to have some actively growing plants from early spring to late fall. Most dairymen find that an excess of forage exists in the spring and an insufficient amount is available in the summer months. The excess should be preserved and fed back during the drought season.

Many dairymen notice a decline in milk production in their herds about the middle of June. Table 1 and the figure above will help to explain the reason for the decline in production. Most of the decline is blamed on hot weather and flies but is really the result of underfeeding. Dairymen have been able to prevent most of the decline by providing hay or silage for the cattle at all times, even when the pasture is very lush in the spring. A supplemental pasture such as Sudan grass has proven very satisfactory also.



Excess pasture growth in the spring can be stored for use later in the season.

A study of DHIA records shows that cows in herds provided supplemental feed (hay or silage) while on pasture produce 1,000 pounds or more milk than cows in herds not receiving supplemental feeds. Depending upon the size of the herd, the price of milk, and the response of the cows to supplemental feed, this could result in a sizable increase in income for the dairyman.

GREEN FEEDING OR ZERO PASTURE

Zero pasture is a modification of the old soiling system that consisted of growing a crop, cutting it with a scythe or mowing machine, forking it into a wagon, and feeding it green to animals in stanchions or feed lot. With modern forage harvesting and handling equipment, it becomes a practical method for large modern farms because the high labor load is eliminated.

Green feeding provides rotational management of pasture and hay land through machines, without fencing, and the cattle are fed the freshly chopped material in feed bunks or self-feeding wagons. Under this system of feeding, the cattle consume larger amounts of green forage and have access to water, hay and silage, as well as shade, in the feed lots.

This system of zero pasture increases the nutrients delivered from an acre of pasture. Dairymen claim one-third more cows can be fed from the same area when this method is used as compared to the usual grazing system. There is no waste, no pollution, or problems arising from selective grazing by the animals.

ESTIMATING FEED NEEDS FOR THE YEAR

Cows will consume 2.5 pounds of good hay equivalent (three pounds silage equals one pound hay) per 100 pounds bodyweight without difficulty when fed

forages cut in early June. They will eat smaller quantities of forages cut at later dates.

If hay is fed as the only roughage, four tons of hay per cow should be provided for the barn feeding season (approximately 240 days). If hay is fed in combination with silage, each cow should have two tons of hay and six tons of either grass or corn silage. In addition, approximately one ton of hay or three tons of silage should be provided to supplement the pastures.

A yearling heifer needs about two-thirds as much hay as a cow of the same breed; a one-year-old calf needs about one-third as much as a cow.

The following factors will assist you in calculating the amount of good hay equivalent you have provided for your herd: good hay, 1.0; fair hay, 0.8; poor hay, 0.6; and silage, 0.33. To find good hay equivalent, multiply tons of hay by its respective factor and add together.

NOTES

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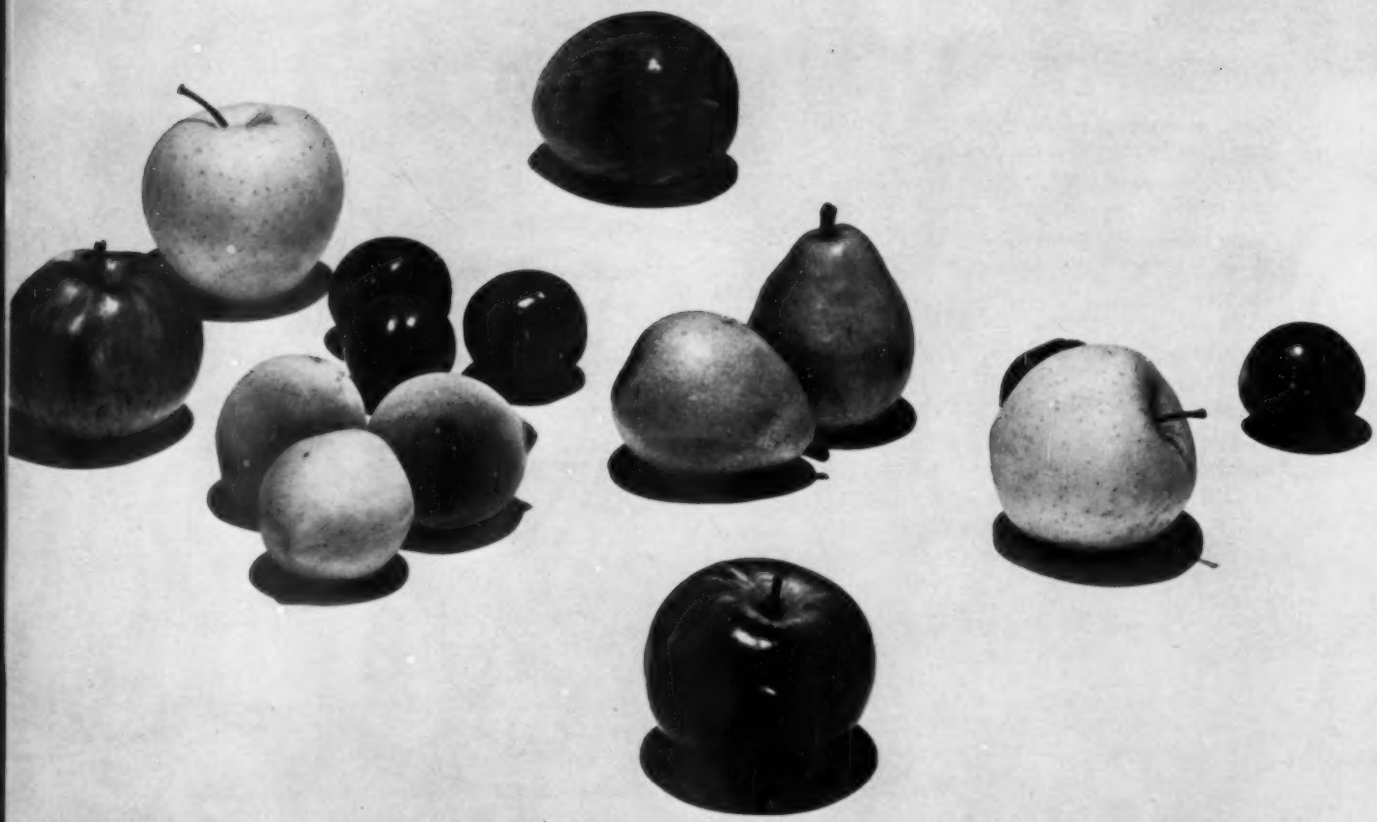
1961

Tree-Fruit Production Recommendations



New York State College of Agriculture

1961
TREE-FRUIT PRODUCTION RECOMMENDATIONS

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Apples

LOCATION OF THE ORCHARD

For profitable fruit production there is no substitute for a good soil. Under New York conditions, most soils are filled with water at some time of the year and may at other times become quite dry. The roots of perennial fruit trees must live throughout the year under these widely fluctuating moisture conditions. The roots must furnish the tops with large amounts of water from bud burst in late April until leaf-fall. During this period not only is water required in available form, but the pore space of the soil must contain air for the production and growth of new rootlets that constitute the absorbing surface of the root system. Because much of this absorbing surface normally dies during winter, the soil should be drained and aerated well enough to allow its regeneration by the beginning of top growth in early spring.

In imperfectly drained soils there may be either limited pore space because of packing, or too much pore space filled with water rather than air. Such situations not only decrease the extent and depth of rooting, but prevent the roots from completely exploring that portion of the soil in which they are able to exist. The effect of too much water or too little air in the soil for any part of the season is to reduce root development to such an extent that the root system is unable to take in the water and nutrients required by the tree for the entire season.

In wet years, a few trees may die from poor soil drainage. On such soils, however, the tragedy is that the trees usually remain alive, make moderate growth, and produce low yields year after year.

In addition to being well drained and aerated, a good orchard soil will retain a large reservoir of available water. The amount held in the root zone should equal 6 to 8 inches of rainfall. During dry spells tree roots will tap this reserve water supply. Because light-textured soils have less capacity to hold available water than do loams, rooting must go much deeper on the former than on the latter. Usually 6 to 8 feet of extensive rooting on sandy soils will support good tree growth and high yields, and 3½ to 4 feet on finer textured loamy soils will suffice for equally good performance.

Over the years climate has defined the boundaries of the fruit districts in New York State. These districts are reasonably free of late spring frosts and seldom experience the low winter minimums that characterize other parts of the State. However, frosts do occur occasionally at bloom time in all New York fruit growing regions. When this happens, trees located in so-called frost pockets may have their crops seriously reduced. Flatland surrounded by hills that prevent air drainage, or rolling land where large areas form frost pockets is better adapted to annual crops, forest, or recreation than to fruit. When orchards are located outside of the recognized fruit districts, the site must have sufficient elevation for air drainage and frost protection to assure annual crops.

VARIETIES

The following list of suggested varieties includes only those harvested during the September to November period. Early varieties will be profitable so long as no more are produced than can be immediately disposed of in local markets or through roadside channels. The market for summer apples is limited and the main bulk of New York's apple production should be of varieties that ripen from the McIntosh season through the first part of November.

The list includes 10 varieties in approximate order of their dates of maturity. To avoid picking immature or overripe fruit, it is usually unwise to produce more apples of any one variety than can be harvested and stored within a 10-day or 2-week period in the average year. With the earlier maturing varieties, such as McIntosh growing in the more southern parts of the State, a harvest period of no more than a week may be desirable. The acceptable harvest period of McIntosh in the northern areas of the State may be somewhat longer because of lower average mean temperatures.

McIntosh is especially adapted to the more northern areas of New York. A standard dessert variety in the Northeast, it is one of the best varieties for controlled atmosphere storage. The planting of a red-color sport such as Rogers, Cornell, Bollers or Geneva McIntosh is probably desirable.

Cortland is a hardy, annually productive tree. For best storage quality, the variety must be picked with or immediately after McIntosh.

Jonathan is suggested to fill in the slack picking time between McIntosh and Delicious. It must be spray-thinned, but is adapted to controlled atmosphere storage.

***Twenty ounce** is a large-sized fruit and annual bearing tree. It has been one of the more profitable varieties for growers of processing fruit.

Delicious is specifically a dessert apple. The planting of red or so-called double-red color sports of Delicious, Starking or Richared, is probably desirable. Unfortunately these color sports have not been sufficiently tested in New York to make firm suggestions. Vance Delicious is worthy of extensive trial. Imperial and Royal Red Delicious as well as the spur-types, Redspur and Starkrimson, show promise. The spur-type tree is reported to produce a smaller tree than regular Delicious.

***Rhode Island Greening** is one of the best processing varieties. Occasionally it tends toward biennial bearing but can be made annual with spray thinning. In the past, this variety often has been harvested too early for maximum processing quality and production.

***Monroe** is a better annual producer than Rhode Island Greening. Primarily a processing variety, it also has acceptable dessert quality.

****Idared** maintains condition for a long marketing season from mid-winter to late spring. Its harvest season is between Delicious and Golden Delicious.

****Golden Delicious** must be spray thinned. The variety tends to russet easily. A site with good air drainage and a special spray program are needed to help control this problem. The fresh fruit market has shown strong demand for large-size, russet-free Golden Delicious. For processing there would be no objection to russet, but small green fruits resulting from insufficient thinning should be avoided.

****Rome Beauty** is probably sufficiently planted at present to meet the future demand. For growers who wish the variety to fill in the last picking slot, Clift or Mills color sports are suggested.

ROOTSTOCKS

Size-controlling or dwarfing rootstocks that have been sufficiently tested to make a firm suggestion are seedlings, EM II and EM VII. EM II is preferred for the lighter and dryer soils and EM VII for the heavier soils. EM II causes less growth restriction than EM VII, and is preferred for those varieties which, by nature, do not develop into large trees; *e.g.*, Yellow Transparent and Rome.

Trees on size-controlling rootstocks may begin bearing at a slightly earlier age than trees on seedling rootstocks. However, trees on seedling rootstocks will be larger after a 10-year period. Total yield records of individual trees over the first 10 or 12 years have not shown a decided yield advantage for either stock. The only advantage is obtained when the trees on size-controlling rootstocks are planted closely in the orchard. At the age of 10 or 12 years, this close spacing may be maintained while orchards on seedling rootstocks, if planted closely, will need partial tree removal.

Ideal orchard spacing depends upon type of rootstock, scion vigor, soil adaptability, and the desire of the grower for either an early-bearing, short-lived orchard or a later-bearing, long-lived orchard. Suggested planting distances are as follows: EM II, 15 feet or 20 feet by 30 feet; EM VII, 15 feet by 30 feet; and, seedling rootstocks, 20 feet by 40 feet. Mature orchards on seedling stocks ultimately should be thinned to 40 feet by 40 feet.

The bud on all trees with clonal rootstocks should be high enough for the trees to be planted deeply enough for good anchorage without danger of scion rooting.

SOIL MANAGEMENT

Sod competition around young trees must be eliminated by cultivation, mulching, or herbicides. Cultivation or chemical weed control must be applied at or before tree growth commences. Cultivation should cease by the end of June.

Sod culture with supplementary nitrogen fertilization is recommended for mature trees. Additions of mulching materials under the trees can furnish part or all the supplementary nitrogen. A sod cover growth composed mainly of Kentucky bluegrass is usually satisfactory. All orchards should be limed periodically to maintain a surface soil pH of 6.0.

The soil underneath the trees is usually more acid, and limestone applications should be heavier here than between rows. If sod growth is poor, 75 pounds of ammonium nitrate per acre should be broadcast in addition to the limestone application. If soil analysis shows phosphorous and potassium to be deficient, a 10–10–10 mixed fertilizer at the rate of 250 pounds per acre can be substituted for the ammonium nitrate. A vigorous orchard sod should be mowed several times during the growing season.

FERTILIZATION

Nitrogen

Rates of nitrogen fertilizer suggested for apple trees are listed in table 1. These rates are suggested for average soil conditions and adjustments must be made according to individual orchards and tree variability.

*Processing varieties
**Dual purpose varieties

Table 1. Number of pounds of nitrogen fertilizer suggested for apple trees*

Tree age	Sod		Cultivation	
	NH_4NO_3**	10–10–10	NH_4NO_3	10–10–10
Years	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1–3	—	—	—	¼–½
3–4	—	—	—	½–2
5–10	1–2	3–6	½–1½	2–4½
11–15	2–3	6–9	1–2	3–6†
16–20	3–4	9–12	1–3	4–9†
over 20	4–5	12–15	2–4	5–11†

*McIntosh should generally receive the lower suggested rate.
**NH_4NO_3 is nitrate of ammonia.
†Cultivation is not suggested for apple trees over 10 years of age, but rates are given for the few orchards so handled.

Table 2. Common nitrogen fertilizer materials

Material	Percent	Pounds needed to equal 100 pounds nitrate of ammonia
Urea	45	73
Ammonium nitrate	33	100
Sodium nitrate	16	206
Sodium-potassium nitrate	15	207
10–10–10	10	330

Each of the common nitrogen fertilizer materials has value for special purposes. For general use, ammonium nitrate is suggested. Nitrogen should be applied to mature apple trees in late November or in early spring about a month before bloom.

Potassium

The need for potassium fertilizer can be determined by leaf and soil analysis, leaf symptoms, and a history of the site. Potassium deficiency is more likely to occur on old orchard sites, sandy or gravelly soils, poorly drained soils, or on soils high in pH, calcium, and magnesium.

The kinds of potassium fertilizer most commonly available are:

Material	Percent Potash (K_2O)
Mulch	.5 to 5.0
Muriate of potash	60
Sulfate of potash	50
Sulfate of potash magnesia	22
Sodium-potassium nitrate	14
10–10–10	10

Mulch, sodium-potassium nitrate, and 10–10–10 have value only if maintenance rates of potassium are needed along with nitrogen. Sulfate of potash magnesia is the best choice if magnesium and potassium are both low. Muriate of potash can be used if magnesium is satisfactory and moderate rates of potassium are needed. A mature tree usually should receive no more than 5 pounds of muriate of potash in any one year and no more than 10 pounds in a 3-year period. Sulfate of potash should be applied where heavier rates of application are needed.

Magnesium

All orchards should receive periodic limestone applications to maintain a surface soil pH of 6.0. If magnesium deficiency is serious, soil applications of kieserite or foliage sprays of epsom salts may be needed. Kieserite should be used at the rate of 10 to 20 pounds per mature tree. Three sprays of epsom salts at 15 pounds per 100 gallons are suggested for severely deficient apple trees. *The sprays should be applied dilute and should not be combined with lead arsenate insecticide sprays.*

Boron

Boron deficiency symptoms are more likely to occur in McIntosh or varieties having McIntosh parentage during drought summers. If such boron deficiency symptoms as internal corking have occurred, fertilizer borate, high grade or agricultural pentahydrate borox, should be applied to the soil approximately every 3 years at the following rates:

Approximate trunk diameter 1 foot above ground	Amount of fertilizer grade borax
inches	*ounces*
3½	2
5	4
7	6
10	8
14	8–12
15	12–16

The borax should be applied in the early spring in a narrow (4 to 10 inch) ring a foot or two in from the tips of the branches.

Most growers now prefer to substitute annual boron sprays for applications of borax to the soil. Highly soluble preparations consisting of sodium pentaborate, Solubor or Boro-Spray, may be added to 1 or 2 regular sprays, 1 to 3 weeks after petal fall. Fertilizer grades of borax often contain grit and should never be used in a sprayer.

Average-sized bearing trees should receive 4 pounds per acre each year, preferably 2 pounds per acre in each of 2 sprays. If 550 gallons of dilute spray are applied per acre, about ⅜ pound of sodium pentaborate per 100 gallons in 2 sprays would make 4 pounds per acre. Boron does not move freely from one branch to another after it has been absorbed by the

leaves. Consequently, boron sprays should be thoroughly applied. In experimental tests, boron sprays have been concentrated 2 times with satisfactory results.

CHEMICAL THINNING

Naphthaleneacetic acid and naphthalacetamide are the two growth regulators recommended for chemical thinning. The outstanding feature of the growth regulators is their use in the post-bloom period, when the set and need for thinning can be more easily determined. There is also evidence that these chemicals result in more flower bud formation than can be accounted for in the amount of thinning accomplished. For these reasons, naphthaleneacetic acid and naphthalacetamide are preferred in the Northeast. Naphthalacetamide has label clearance and can be recommended for use in 1961. To date naphthaleneacetic acid and the DN materials are not cleared for use in 1961, but may be granted label clearance in the near future. Consult your county agent regarding their clearance for thinning use in 1961.

Dinitro materials, or DNs, have been employed for thinning heavy-setting varieties in New York and are still used in other areas. Favorable results with DNs depend on a rapid development of bloom and relatively dry weather, but these conditions cannot be depended upon in the Northeast.

Time of Application

Thinning sprays on summer varieties (Red Astrachan, Transparent, Lodi, Dutchess) should be made within the seven-day period following full bloom. Later sprays cause premature ripening of the fruit and should be avoided. To minimize leaf injury, naphthalacetamide (the amide) is the better choice for early apples.

Fall and winter varieties may be spray thinned any time during the 18-day period following full bloom. This allows time to appraise the set, consider weather conditions that may affect results, and select a favorable day for the treatment. Sprays applied close to 18 days after full bloom appear to cause an increase in blossom bud formation for the following year.

The use of amide on Red Delicious should be limited to the petal-fall stage to avoid small seedless fruits (pygmies). If a later date is preferred, naphthaleneacetic acid (NAA) should be used. The use of NAA, 14 to 18 days after bloom, has given the most consistent results with Golden Delicious and Rome Beauty.

Factors Affecting Chemical Thinning

Many factors influence spray-thinning results. Most favorable responses cannot always be duplicated. Despite this, spray thinning has become an accepted practice with many fruit growers.

Exposure to freezing temperatures (26° F. to 28° F.) or a week or more of cloudy, wet weather before treatment results in maximum absorption of the chemical and greater thinning. Freezing temperatures frequently occur in the low spots, leaving foliage of trees on higher ground unaffected. Lower concentrations should be used where foliage is exposed to such adverse weather conditions.

A calm, warm day when a maximum temperature of about 75° F. is predicted is considered ideal for applying the spray.

Trees should be sprayed thoroughly at dilute concentrations. The top of the tree should be well covered; the bottom sprayed as needed in crowded plantings. Do not mix growth regulators and pesticides in the same spray mixture.

Do not spray trees under 14 to 16 years of age unless they have become biennial in bearing.

Suggested concentrations of amide and NAA for the most commonly grown New York apple varieties are listed in table 3.

Table 3. Appropriate concentrations for thinning certain apple varieties

Variety	Amide (Naphthylacetamide)	NAA (Naphthaleneacetic acid)
	*Parts per million**	*Parts per million**
Lodi	35–50	——
Yellow Transparent	35–50	——
Melba	35–50	——
Oldenburg (Duchess)	50–75	——
Early McIntosh	35–50	——
Milton	35–50	5–10
Wealthy	75	20–35
Jonathan	35–50	5–10
McIntosh	35–50	10–15
Cortland	35–50	10–15
R. I. Greening	35–50	5–10
Macoun**	35–50 (petal fall)	5–10
N. W. Greening	35–50	5–10
Delicious**	35–50 (petal fall)	5–10
Baldwin	35–50	15–20
Northern Spy	35–50	5–10
Golden Delicious	——	10–20
Yellow Newtown	35–50	15–20
Rome Beauty	50–75	15–20
Ben Davis	35–50	10–15

*Lower concentration suggested for conditions favorable for absorption.
**To avoid pygmies on Delicious, Macoun and other varieties responding in this way, limit Amide to the petal fall stage or use NAA at a later date.

Table 4. Approximate number of days over which a harvest spray will control apple drop

Material	Concentration	McIntosh	Later varieties
	Parts per million	*Days*	*Weeks*
NAA	10	6	—
	20	10	—
TP	10	10	2
	20	18	3–4

CONTROLLING HARVEST DROP

To date no material has been granted label clearance for drop control of apples. The indications are that naphthaleneacetic acid (NAA) and 2,4,5–trichlorophenoxypropionic acid (TP) will be given label clearance, but you should consult your fruit agent before using them.

The drop of apples during the harvest season depends on several factors, but is most closely associated with the maturity of the fruit. Hot weather hastens ripening and increases the rate of drop; cool weather will reduce drop. The percentage of fruit dropping during harvest is less with a light crop than with a heavy crop.

Chemicals used for drop control will stimulate ripening. NAA stimulates ripening less than TP. To avoid over maturity with McIntosh, delay the spray until drop is indicated. Harvest as many McIntosh as possible before spraying.

TP is adapted for hard varieties maturing after McIntosh. For Delicious, the concentration of TP should not exceed 10 parts per million. TP may be used at 20 parts per million on other late varieties. For these reasons, it is necessary to apply the spray before the foliage is frosted or senescence develops from other causes. Spraying on a warm day, 70° F. or above, is preferred.

After a consideration of the crop, its condition, and time required for harvest, table 4 may be helpful in choosing the material and concentration.

ORCHARD MOUSE CONTROL[1]

Two species of mice can be troublesome in the orchard. The field mouse is widely distributed throughout New York State. Damage caused by this mouse is most severe at or near the surface of the ground. The pine mouse, confined to some of the southern areas of the Hudson Valley, burrows more deeply than the field mouse, is more difficult to control, and causes more severe damage to the tree.

Mice usually girdle fruit trees during late fall, winter, and early spring when succulent green vegetation is at a minimum. Control operations should be conducted after harvest in early November, before the first snowfall. The orchard should be examined during open periods of winter when snow may be off the ground. If mouse signs are present, control operations should be repeated. An annual program for control of mice must be maintained in the orchard. The best remedy for mouse damage is prevention. If girdling does occur, bridge-grafting can be used to save the trees. Information on procedures for bridge-grafting may be obtained from your fruit agent. Practices necessary for mouse control are as follows:

Protect trunks of young trees with a wire guard. One-quarter inch wire mesh has proved most satisfactory. Embed the guard at least 6 inches beneath the soil surface.

Keep the area within 2 or 3 feet of the trunk free of ground cover. The use of herbicides can be helpful. When scraping the soil in the fall, do not expose previously covered bark. This tissue is highly susceptible to winter injury.

A layer of crushed stone or coarse cinders around the base of older trees can discourage mice.

Never allow newly cut prunings to accumulate for any period of time around the base of trees.

The use of endrin and other ground sprays may be more effective against the pine mouse. Use of poison baits for the control of meadow mice is the practice most commonly used by fruit growers in New York.

Studies have shown that meadow mice forage widely from their runways and readily locate grain baits scattered at random in the vegetation. Several methods of baiting the orchard mechanically have been developed to take advantage of these facts. These methods are especially suitable for large commercial orchards because labor costs are greatly reduced, and the baiting may be done quickly to take advantage of good weather.

A zinc-phosphide - cracked corn bait suitable for machine baiting may be prepared according to the following formula:

Coarsely cracked corn—100 pounds
Zinc-Phosphide (pure)—2 pounds
Vegetable oil—1 quart
Methyl Green Dye—½ ounce

Work outdoors or in an open shed, and wear gloves. Avoid breathing dust or fumes. Mix the methyl green dye with the dry zinc-phosphide and then add the oil to form a thin paste. Pour this mixture over the

[1]Prepared by R. W. Eadie, Department of Conservation, New York State College of Agriculture.

cracked corn in a large metal tub and use a hoe to mix the mass until each grain is uniformly coated. Larger quantities of bait can be prepared in a cement mixer or tumble mixer.

Prepared grain placed in sacks and stored in a dry place will keep for 6 months but should not be kept from one year to the next. Prepared bait of this type also is available through commercial sources. The green dye and black color of the zinc-phosphide serve to disguise the grain and deter birds from eating any they may find.

Mouse control has been obtained by using 3 or 4 pounds of bait per acre with hand or tractor-operated seeding devices; 8 or 10 pounds of bait per acre with tractor mounted, whirling-disc type broadcast fertilizer spreaders; and with 6 to 8 pounds of bait per acre applied by airplanes.

HERBICIDES

Chemical sprays can save considerable time and effort in the control of weeds around fruit trees. Sprays can be applied to eliminate weed competition around trees, and to provide a weed-free area around the trunks of trees to simplify mouse control. Sprays over the complete orchard floor have successfully replaced cultivation in fruits such as grapes, peaches, and cherries which normally require cultivation for the maintenance of tree vigor.

To prevent possible injury to trees sprayed with herbicides, the factors discussed below must be considered.

The rate of application must be carefully controlled. If the amount of herbicide desired per acre is dissolved or suspended in 100 gallons of spray solution, then each gallon of spray solution should cover the number of trees listed in table 5. Spraying distance from the tree is calculated as a square, reaching all four sides of the tree.

Table 5. Number of trees to cover with 1 or 100 gallons of herbicide spray solution

Distance sprayed from the trunk	Number of trees per 100 gallons	Number of trees per gallon
Feet		
3	1210	12
4	681	7
5	436	4
6	303	3
7	222	2
8	170	1 3/4
9	134	1 1/3
10	109	1
11	90	9/10
12	75	3/4
13	64	2/3
14	56	3/5
15	48	1/2

Adequate mechanical or jet agitation deponds on the type of sprayer used, the number of nozzles used, and the capacity of the pump. Many of the herbicides used for weed control are wettable powders that form suspensions rather than true solutions. If agitation is not sufficient, the materials will settle out and result in a higher concentration of herbicides in the bottom of the tank. This, in turn, could cause serious injury when the mixture is applied around the trees.

An 80 degree fan type weed spray nozzle that delivers 100 gallons per acre at a convenient speed of hand or tractor application has proven effective for applying herbicides in the orchard. Careful calibrations of spray machinery should be made to prevent overdosage of herbicides. Enough spray solution to wet the grass, without excessive run-off is usually sufficient.

Sprays should be applied at the rate of 100 gallons of the spray mixture per acre of treated area. The pressure at which the spray is applied should be about 30 to 40 pounds. Low gallonage rates and low pressure help avoid forcing the spray into the soil—a common cause of herbicide injury.

Suggested herbicides

Dowpon is the only herbicide that has label clearance for summer use on apples. Several other materials may be given label clearance by the spring of 1961. This information will be released through your county agent as it becomes available. The following suggestions apply to nonbearing trees only. No attempt is made to cover every weed situation. Consult your county agent for materials to use for special weed problems.

Program 1—Cultivate, rototill or otherwise remove weed cover in the early spring. Apply Simazine (80 percent commercial product) at a rate of 3¾ to 5 pounds per acre on the area actually sprayed. Experimental results with Simazine indicate that it can be used safely and effectively on young apple, sweet cherry, and sour cherry.

Program 2—This treatment is effective if the weed cover is primarily grass. Spraying should be delayed until the grass is 4 to 6 inches high. A combination spray of Dowpon, 8 to 10 pounds, plus Simazine (80 percent commercial product), 3¾ to 5 pounds, per acre on the area actually sprayed will control the grass. If broadleaf weeds develop, a low volatile salt formulation of 2,4–D at 1 to 1½ pounds per acre can be used on most apple varieties at a later date. 2,4–D should not be used around pear or Winesap apple trees. Extreme care should be exercised to direct the spray to the weeds and away from the tree foliage. An

alternate spray for broadleaf weeds is a DN-oil emulsion spray (2 to 3 pints of Dow General or Sinox General contact weed killer plus 10 gallons oil diluted to 100 gallons with water).

FUNGICIDES

Captan (50 percent wettable powder) still appears to be one of the most effective fungicides for apple scab control. In addition to protective action, captan also gives some after-infection control. Present evidence indicates it cannot be relied upon for control when applied more than 18 to 24 hours after the beginning of rain at an average temperature of 50°F. Captan has consistently given the highest finish of any fungicide tested on Golden Delicious. Captan has caused leaf spotting, yellowing, and dropping of leaves when used at full strength early in the season on Red Delicious. Sulfur sprays immediately preceding captan appear to increase injury. Do not use sulfur in combination with captan on Red Delicious, Baldwin, or King. Bordeaux-oil sprays were shown to increase captan injury to Red Delicious. Captan has been used successfully on a weekly spray schedule in New York. However, the spray interval should be shortened if excess washing of the spray residue occurs, or if there is rapid growth and expansion of new tissue during a critical period for spore discharge. Captan is compatible with mercury and can be used in the half-and-half mixtures to increase back-kick or eradication properties. Captan also can be used in combination with sulfur or Karathane for mildew control except on varieties mentioned above. It provides favorable correction for arsenical injury.

Dodine (Cyprex, 65 percent wettable powder) at ½ pound is an excellent scab fungicide. Its high degree of effectiveness can be attributed partly to some local systemic action. Present evidence indicates it will eradicate scab infection for 20 to 28 hours after the beginning of a rain. Dodine may cause fruit injury if applied at freezing or near freezing temperatures, particularly when accompanied by slow drying conditions. Oil should not be added to dodine or serious injury to fruit and foliage may occur. This fungicide does not correct for arsenical injury and ferbam should be added for arsenical correction. Dodine will russet Golden Delicious. It is compatible with captan, ferbam, sulfur, Karathane, mercury compounds, glyodin and the standard insecticides, although some fruit russet has been noted in 1960 on McIntosh at the rate of ½ pound in combination with either captan or sulfur. If desired, dodine could be used with mercury compounds to increase interval for scab eradication. The addition of sulfur or Karathane may be needed for control of powdery mildew. Dodine is not very effective in the control of rust diseases on apples. It can cause severe foliage injury on peaches, plums, and some varieties of pears. Some growers following good spray practices in orchards with relatively light scab carry-over have obtained excellent protective control of scab with dodine at rates of ¼ to ⅜ pound per 100 gallons. In a grower program (largely protective) dodine applied by airplane as a 3 or 4-percent dust has provided excellent scab control in experimental blocks dusted on a commercial scale.

Ferbam (76 percent wettable powder) is safe on apple foliage but has caused considerable enlargement of fruit lenticles in certain seasons and causes russeting on Golden Delicious. Ferbam is less effective than paste sulfurs as a protectant against leaf scab at 1½ pounds, but equals 5 pounds of actual sulfur in the control of fruit scab. It is useful alone or in combination with other fungicides for the control of rust diseases and sooty blotch. Ferbam at ½ pound per 100 gallons gives adequate correction of arsenical injury for up to 3 pounds of lead in 100 gallons of spray. It can be used at half strength with half strength mercury as an eradicant scab spray, although the eradicative effectiveness of mercury is somewhat reduced when used in this combination. It is also compatible with sulfur and Karathane in mildew sprays.

Glyodin (30 percent liquid formulation) has been an effective protectant against scab at 2 pints during primary scab and at 1 pint to 1½ pints in later sprays. It should not be used on apples at dosages of over 2 pints per 100 gallons. Glyodin tends to increase arsenical injury on susceptible varieties such as Rhode Island Greening, Cortland, and to a much less degree on McIntosh. Fresh hydrated lime used at the same rate as lead arsenate has provided satisfactory correction some years, but not during hot summers that are particularly favorable for arsenical injury. During several seasons either ferbam, ½ pound per 100, or Nu-Iron, ½ pound per 100, added to the glyodin-lead arsenate mixture was more effective than was the lime. The remarks made above for glyodin also apply to glyoxide (50 percent wettable powder). The 50 percent wettable powder formulation has appeared to be a little safer than the 30 percent solution for fruit finish. Glyodin and glyoxide are compatible with mercury and can be used in the half-and-half mixtures. Both materials are compatible with sulfur and Karathane and can be used in combinations for powdery mildew control.

Sulfur compounds. Magnetic 70 paste is recommended at the rate of 7 pounds per 100 gallons of dilute spray. The rate should be increased to 8 or 9 pounds if used in the rain. Magnetic 70 is somewhat more expensive than other sulfurs, but is easier to handle and is preferred by many growers. Dry wettable sulfurs are used at a rate of 5 pounds dilute (7 to 8 pounds plus oil-type sticker in rain) in early season sprays in a protective program. Critical tests indicate that most of the dry wettable sulfurs are slightly inferior to the paste sulfurs in scab control. Sulfur dusts are valuable supplements to sulfur sprays in early season applications. Dusting during the rain before infection occurs is the most effective method. The finer divided dusts are more adherent and more effective.

Sulfur has no scab eradication action. The sulfur compounds are very effective materials for scab control when properly timed in a protective program. They may be used up to and including bloom without reduction in fruit set. In post bloom sprays, sulfur may cause fruit russeting and reduction in yields. All sulfur formulations have been reported to increase captan injury on susceptible varieties. Sulfur sprays control powdery mildew when used in the pre-bloom sprays and in sprays through the terminal growth period.

Mercury compounds. Phenyl mercury compounds may be used at full strength for eradication of apple scab within 60 to 72 hours after infection. The effective period varies with the temperature. These compounds, particularly at full strength, cause injury when applied on wet foliage, especially during or preceding high temperatures. Foliage injury, fruit russeting, and reduction of blossom formation and fruit set may follow repeated applications of mercury, particularly at full strength. The use of half-strength mercury with half-strength sulfur, or with one of the organic fungicides, has appeared to reduce the amount of injury but also reduces the period of after-rain effectiveness. Post-bloom sprays of mercury during or preceding high temperatures have caused severe leaf injury, leaf drop, reduction in fruit set, and in some instances severe fruit drop. Straight pre-cover schedules of mercury have caused considerable foliage injury, reduced fruit set, and fruit russeting. Mercury should be limited to use in pre-bloom after-infection sprays when the effectiveness of the preventive spray program is in doubt. When the spray can be applied soon after the rain, one of the half-strength mercury combinations is preferable to the full strength. Recent experimental evidence indicates that a methyl mercury compound (LM Apple Spray) is less injurious than phenyl mercury but is somewhat less effective against scab. It could be used on a trial basis.

Dichlone (Phygon XL, 50 percent wettable powder), except for the organic mercuries, has the greatest eradicative action of the scab fungicides (30 to 48 hours). It should be used at the rate of ¼ pound unless a specific need requires a higher rate (½ pound) for eradicative effect. Reported use of dichlone, particularly at higher temperatures and beyond the pre-cover period, may result in excessive injury to fruit and foliage. Apparently this fungicide is less safe under Hudson Valley conditions, where it caused serious russeting on several varieties in 1952 and 1957, than in northern New England and in the Champlain Valley. Where dichlone is used for after-infection scab control, a half-and-half mixture of dichlone with ferbam is suggested because the latter tends to reduce dichlone injury. Use of dichlone should be avoided during low temperatures, for it appears to increase fruit russet, particularly when used with sulfur. In experimental and commercial plantings, dichlone applied by airplane as a 3 percent dust has provided very satisfactory commercial control of scab.

Niacide A and M perform about the same as ferbam for controlling apple scab and cedar rusts when used at the 2-pound rate. Fruit finish of McIntosh, Cortland, Jonathan, and Delicious has been good. Results in western New York have been satisfactory in scab control and fruit finish on McIntosh and Cortland if protection only was involved. Reports from some other states have been less favorable. It appears that this material could be used on about the same basis as ferbam. Niacide M appears safer than Niacide A as far as fruit finish is concerned.

Phybam-S at the rate of 4 pounds contains ¼ pound Phygon, ½ pound ferbam, and 3 pounds sulfur. Used through petal fall, Phybam-S has given good control of apple scab, apple rust, and powdery mildew. There has been less injury with Phybam-S than with Phygon alone.

Thiram (65 percent wettable powder) looks promising in the Hudson Valley as a substitute for ferbam on varieties subject to fruit russet when both scab and rust diseases must be controlled. It also has been used in combination with captan with good results. Thiram at 2 pounds has been superior to ferbam for scab control and fruit finish in the Hudson Valley and western New York. In western New York, the combination of thiram-lead arsenate caused light to moderate arsenical foliage injury on McIntosh and Cortland. In western New York, where cedar rust has not been a problem, thiram seems to have no particular advantage.

Spray Schedule for Apples

Because of variations in importance of insects and diseases with locality and year, the following recommendations must be considered as a general outline and modified to meet the actual conditions in the orchards. In counties where the Extension Service conducts a spray-information service, valuable assistance may be obtained in adapting the general recommendations to individual needs.

DORMANT STAGE

Dormant spray

Time: After buds begin to swell, but before they show green at the tip.

Insects: Rosy aphid, green aphid, eye-spotted bud moth, oystershell scale, San José scale.

Recommended materials per 100 gallons:

DNC .....1½ quarts or 1½ pounds

or

DNBP ..... 1 quart

Comments: Three to 4 pounds or quarts of DNC are needed for oyster-shell scale and bud moth. One quart of DNBP is needed for aphids; 2 quarts for bud moth, San José scale and scurfy scale; 3 to 4 quarts for oyster-shell scale. DNBP materials should not be used when green tissue is showing. DNC materials have been used safely with as much as ⅛ inch of green tissue showing, but this is not considered a good practice. DNC contains dinitro ortho cresol, sold in liquid and powder form as Elgeton, Krenite, DN Dry Mix Number 2, Dinitro Dry and Ortazol Powder. DNBP contains dinitro secondary butyl phenol and is sold as DN-289 and Elgetol 318.

SEMI-DORMANT STAGE

Silver-tip spray

Time: When blossom buds begin to show silvery tips.

Diseases: Apple scab.

Recommended materials per 100 gallons: See list of recommended materials under pre-pink spray.

Comments: The first danger of apple scab infection is on the sepals when the fruit buds are in the silver-tip stage. If scab spores are mature, silver-tip or early green-tip infection is possible. Under such conditions, an additional early application of fungicide may be required for scab control.

Green-tip spray and delayed-dormant spray

Time: *Green tip*—when blossom buds are bursting and show from ⅛ to ¼ inch of green; *Delayed-dormant*—when leaves of blossom buds are out from ¼ to ½ inch.

Diseases: Apple scab, powdery mildew, black rot.

Insects: European red mite, fruit-tree leaf roller, San José scale.

Recommended materials per 100 gallons:

Superior type oil, 70 second viscosity or 100 second viscosity .....2 gallons

plus

Glyodin .....1 quart

or

Ferbam .....1½ pounds

or

Fixed copper .....Manufacturer's directions.

Comments: Three gallons of oil are required for scurfy scale and fruit-tree leaf roller control. More than one spray may be required during this period for apple scab control, but the oil-fungicide formula should be used only once. If powdery mildew is a problem, the recommendations for mildew control given on page 14 should be followed. Oil and sulfur are not compatible and should not be used together. If oil is not used any of the fungicides listed under pre-pink could be used.

The delayed-dormant spray is important in scab control, and a fungicide at this stage cannot be safely omitted from any orchard in the State. The proper timing of the spray has been a difficult problem. It is necessary to know the stage of development of the scab fungus in the old fallen leaves, the weather forecasts, the development of the apple buds, and the development of the apple aphids. The increased use of dormant and green-tip sprays for aphid control allows more latitude in timing for scab control.

If a DN spray was omitted or could not be applied for aphid control, BHC, 2 pounds of a 10 percent gamma isomer powder or equivalent; lindane, 1 pound of 25 percent wettable powder; malathion, 2 pounds 25 percent wettable powder; Trithion, 1 pound of 25 percent wettable powder; Guthion, 1 pound of 25 percent wettable powder or ethion, at manufacturer's direction, may be used in the oil-fungicide formula. Best results for aphid control are obtained at the full delayed dormant stage.

Combined aphid and bud moth control may be had with the phosphate insecticides in the oil-fungicide formula. TEPP in the oil-fungicide formula will con-

trol aphids but has no effect on bud moth. TEPP should not be used with lime. None of these materials control oystershell scale.

PRE-BLOSSOM STAGE

The points to be considered in timing the applications are: the occurrence of rain periods, the amount of new growth, and the stage of development of the scab and rusts fungi. In some seasons, two or more pre-blossom applications may be required for effective scab control, especially on extremely susceptible varieties such as McIntosh. This stage is usually broken into two spray periods.

Pre-pink spray

Time: When buds in clusters are short-stemmed and closely packed.

Diseases: Apple scab, powdery mildew, and black rot.

Recommended materials per 100 gallons:

Captan ..... 2 pounds
or
Cyprex ..... ½ pound
or
Ferbam ..... 1½ pounds
or
Glyodin or ..... 1 quart
glyoxide ..... 10 ounces
or
Niacide A or M ..... 2 pounds
or
Sulfur ..... 5 pounds (actual)
or
Mercury compounds ..... Manufacturer's directions
or
Dichlone (phygon) ..... ¼ pound

Comments: Refer to the discussion on each of the materials starting on page 9.

The pre-pink spray should be applied if there has been much new growth since the delayed-dormant period, and if rain is expected or occurs. Delay the application after the delayed-dormant period as long as the weather permits, and make only one application as near to the blossoming as possible. The use of mercury should be limited to pre-bloom sprays (see page 10). Dichlone is likely to cause injury to fruit and foliage when used in sprays after petal-fall.

Pink spray

Time: As late as possible before flowers open.

Diseases: Apple scab, powdery mildew, black rot, apple rusts.

Insects: Fruit-tree leaf roller, green fruit-worm, tarnished plant bug, cankerworms, European red mite.

Recommended materials per 100 gallons:

Choice of fungicide listed under pre-pink stage
plus
DDT ..... 2 pounds
plus
An acaricide as listed under Preventive Programs, page 17.

Comments: The timing of this spray as close as possible to blossoming is important to give adequate protection against scab, black rot and rusts during the bloom period. If the apple rusts are a problem, the addition of ferbam, ¾ pound, should be used in the pink, bloom and petal-fall sprays. Thiram (Thylate) may be substituted for ferbam for combined control of scab and rusts. Phybam-S may be used for combined control of scab, mildew, and rust. DDT, 2 pounds, controls the insects listed above. Tarnished plant bug should be controlled at this time. Control of the other insects could be postponed until the petal-fall spray. Substitute programs for European red mite control, using programs listed under Preventive Programs, page 17, should be included in this spray. *Lead arsenate, sevin or dieldrin should not be used in this spray because they are poisonous to pollinating insects.*

BLOSSOM STAGE

Blossom spray

Time: From the time blossoms first open until the petal-fall stage is reached.

Diseases: Apple scab, powdery mildew, black rot, apple rusts, fire blight.

Comments: In many seasons a bloom application is needed for control of scab, powdery mildew, black rot, and the rusts. The pink spray will not hold these diseases when a long bloom period occurs. In wet seasons the interval between sprays should not extend more than 7 days or should be timed for adequate protection depending on the amount of rain. If possible, it is advisable to wait for adequate pollination (1 to 3 days of favorable weather) before the bloom spray is applied.

In the Hudson Valley, ferbam should be included in the bloom sprays for the control of rusts. Ferbam, 1½ pounds (1 pound on Delicious), or a combination of ¾ ferbam plus ½ strength of one of the other fungicides will protect against rusts. Thylate, 2 pounds, may be substituted for ferbam.

In orchards that received the pre-blossom spray some time in advance of the opening of the blossoms, or where the pre-blossom spray was omitted, or in sea-

sons when the bloom period is unusually long and rainy, bloom applications of elemental sulfur may be valuable for scab control. Yield, however, may be reduced by bloom applications. Captan has appeared to be one of the safer materials for use during bloom. Insecticides should not be included in any bloom application. Mercury compounds should not be used during bloom.

If fire blight is a threat, the fire blight recommendation listed under the pear schedule, page 19 should be followed.

PETAL-FALL AND SUCCEEDING STAGES

In the following pages a basis for choice of materials to combat summer activity of insects and diseases is presented. As the foliage becomes heavier following the petal-fall stage, closer attention is needed to adjust spray machinery of the air-blast type to meet the varied requirements of pests that differ markedly in their habits of attack, particularly if the spray mixture is concentrated.

Petal-fall spray

Time: When the last of the blossom petals are falling.

Diseases: Apple scab, powdery mildew, black rot.

Insects: Plum curculio, red-banded leaf roller, fruit-tree leaf roller, green fruit-worms, European red mite, European apple sawfly (Hudson Valley and Long Island).

Comments: For protection against apple scab and other diseases an organic fungicide should be used. Refer to list of fungicides under the pre-pink stage. Mercury compounds should not be used after bloom. If powdery mildew is a problem, see page 14.

The petal-fall spray is particularly important for the control of the plum curculio, red-banded leaf roller and the European apple sawfly (Hudson Valley and Long Island). The basic insecticide should be selected as a result of observations on the intensity of attack caused by these insects in past years and whether the red-banded has developed resistance to DDD. Other insects present in a susceptible stage of development at petal-fall should also be considered. Refer to Plum Curculio Control recommendation, page 14, and Red-banded Leaf Roller Control recommendations, pages 15–16. If the basic insecticide does not control the fruit-tree leaf roller and green fruit-worms, DDT, 2 pounds, applied in this spray will provide control. If mites have built up, one of the mite control programs recommended on page 17 should also be used.

The European apple sawfly present on Long Island and in the lower Hudson Valley should be controlled at the petal-fall stage. BHC, 2 pounds of the 10 percent gamma isomer, or equivalent strength of the gamma isomer in other formulations, offers the most effective control of this insect. Parathion is almost as effective as BHC but should not be used on McIntosh or related varieties. Dieldrin, ½ pound, controls light infestations but may not provide sufficient control under severe outbreak conditions.

First cover spray

Time: 7 to 12 days after petal fall. In previous years this spray was termed the special scab spray, the 10-day spray, or the pre-cover spray.

Diseases: Apple scab, mildew, black rot.

Insects: Plum curculio, red-banded leaf roller, mites.

Comments: An organic fungicide should be included in this spray to control apple scab. The plum curculio is still active at the time of this spray. However, the red-banded leaf roller is the principal insect to be controlled at this time. Special attention should be paid to applying this spray thoroughly to the undersides of the leaves where the larvae of the red-banded leaf roller feed exclusively. To prevent or reduce damage from succeeding broods, it is important that the first-brood larvae be controlled. By the proper selection of materials, the first cover spray can control the plum curculio and red-banded leaf roller. Refer to the suggestions under the petal-fall spray.

Growers on a preventive European red mite schedule should include an acaricide in this spray (see Schedules listed on page 17).

Other cover sprays

Time: Just before onset of codling moth larval activity on fruit.

Insects: Plum curculio, codling moth, apple maggot, second brood red-banded leaf roller, mites, green aphids.

Diseases: Apple scab, summer diseases of apple.

Comments: An insecticide effective against the plum curculio should be included in the second cover spray. If the primary scab infection period is finished, the fungicides may be reduced to the summer rate (usually ½ to ¾ the rate listed under the pre-pink spray).

In eastern New York, 6 codling moth sprays are normally required to span the period of codling moth activity. In western New York, 5 sprays are usually required. This number varies, however, with the material selected as indicated in table 6.

Apple maggot activity starts about the time of the third cover spray (mid-June). By selecting the proper insecticide, page 16, both codling moth and apple maggot can be controlled effectively. The insecticide

Table 6. Normal interval between cover sprays with various insecticides

Insecticide	Plum curculio	Codling moth	Apple maggot
	Days	*Days*	*Days*
DDT		10	10
DDD		10	10
Methoxychlor	8 to 10	10	10
Lead Arsenate	8 to 10	12 to 14	12 to 14
Parathion	8 to 10	12 to 14	3 to 5
Malathion		12 to 14	2 to 4
Diazinon		10 to 14	10
Guthion	10	10 to 14	10
Sevin		10 to 14	10

program will be changed somewhat in the late July or early August sprays to combat second-brood red-banded leaf roller (refer to the Red-banded Leaf Roller Control recommendations, page 15–16).

A fungicide should be included in the last 2 sprays of the season to protect the fruit from late season apple scab infection and infection from the fungi that cause black rot, sooty blotch and fly speck. Captan (1 pound), plus zineb (1 pound), are suggested.

For the control of red mites or two-spotted mites in July and August, one of programs listed on page 17 may be used.

POWDERY MILDEW CONTROL

The following programs and timing suggestions are offered for powdery mildew control:

		Timing
Program 1		
Standard scab fungicide plus	Half strength	Green-tip through the petal-fall stage.
Sulfur	3 pounds (actual)	
followed by		
Standard scab fungicide plus	Full strength	First cover spray through terminal growth period.
Karathane	½ pound	
Program 2		
Sulfur	5 pounds (actual)	Green-tip through the petal-fall stage.
followed by		
Sulfur	2–4 pounds (actual)	First cover spray through terminal growth period.
Program 3		
Karathane	1 pound	Green-tip through the petal-fall stage.
followed by		
Karathane	½ pound	First cover spray through terminal growth period.

Mildew is most serious on Monroe, Jonathan, Rome, Cortland and Baldwin trees receiving organic fungicides. Sulfur has consistently provided more effective control of powdery mildew than has Karathane. Sulfur at 5 pounds has caused injury in the pink and cluster bud stages. To avoid possible injury, Program 1 is preferred over Program 2. When mildew is not a serious problem, the addition of 1 pound of sulfur or ¼ of Karathane in all sprays has prevented mildew build-up. Two ounces of B-1956 spreader in late sprays will increase effectiveness of materials but, if used in early sprays, may result in poor scab control. Glyodin and Cyprex increase spreading and wetting of sulfur. For effective control of powdery mildew, it is important to start spraying as the buds open, avoid over-extending intervals between sprays (5 to 7 day intervals) and to spray the trees thoroughly. Dilute spraying is more effective than concentrate spraying.

PLUM CURCULIO CONTROL

In the Hudson Valley area from 3 to 4 sprays are needed, beginning at petal-fall stage, for plum curculio control. The sprays are timed from 8 to 12 days apart, depending on the frequency of rains or periods of high temperature. The sprays that cover the period of curculio activity are normally the petal-fall spray, the first cover spray *(known as the curculio, 10-day, or pre-cover spray in the past)*, and the second cover spray. In some years, when cool weather following the petal-fall stage prolongs the period of plum curculio activity, an additional spray may be needed.

In western New York and the Champlain Valley, from 2 to 3 sprays are needed beginning at the petal-fall stage. In most years 2 sprays are sufficient—one at petal-fall and one at first cover (from 7 to 12 days after petal-fall). In recent years curculio activity has been prolonged after petal-fall, and a third spray should be applied.

Materials:

All amounts of insecticides are given in amounts per 100 gallons of dilute spray.

Dieldrin (50 percent wettable powder), ½ pound. Best program where curculio is the major problem. Dieldrin also controls European apply sawfly, tarnished plant bug, and tent caterpillars. Does not control red-banded leaf roller, fruit tree leaf roller, bud moth or mites.

Guthion (25 percent wettable powder), 1 pound. Excellent control of plum curculio. Guthion at 1 pound will also control codling moth, red-banded leaf roller, fruit tree leaf roller, aphids, and will suppress mites. *Cautions and suggestions:* Respirator must be used and all human safety precautions followed.

Parathion (15 percent wettable powder), 2 pounds. Excellent control of plum curculio. Will also control codling moth, European apple sawfly, European red mite, fruit-tree leaf roller, red-banded leaf roller, green-fruit worms, cankerworms, tarnished plant bugs, and scale insects. *Cautions and suggestions:* Severe injury and reduction in yield may occur to McIntosh and its relatives and is not recommended on these

varieties. Parathion may russet Golden Delicious but is safe to use on Rome, Baldwin, Greening, Spy, and possibly other varieties of this nature. Respirator and all human safety measures are required.

Lead arsenate, 3 pounds. Poor curculio control (good enough in very light infestations sometimes encountered in isolated western New York and Champlain Valley orchards). Also controls fruit-tree leaf roller, green fruit-worms, cankerworms and, in light infestations, codling moth.

Methoxychlor (50 percent wettable powder), 3 pounds. Has given excellent control. Also controls fruit-tree leaf roller, green fruitworms, cankerworms and codling moth. *Cautions and suggestions:* Does not control red-banded leaf roller. A strong European red mite control program is needed.

RED-BANDED LEAF ROLLER CONTROL

The selection of a control program will depend on whether the insect populations are resistant to DDD, the variety of apples being sprayed, and the end use of the apples, such as processing apples or apples being produced for fresh fruit. The control of mites, plum curculio, codling moth, and apple maggot should also be considered when selecting a red-banded leaf roller control program.

First Brood Control

Materials:

All amounts of insecticides are given in amounts per 100 gallons of dilute spray.

DDD (50 percent wettable powder), 2 pounds. One application in the first cover spray will control red-banded leaf roller not resistant to DDD. If DDD resistance is suspected, a petal-fall spray will aid control. If DDD resistance is confirmed, use another program. DDD does not control plum curculio.

Guthion (25 percent wettable powder), 1 pound. Good control of normal and DDD resistant populations when applied in petal-fall and first cover sprays. Plum curculio, fruit-tree leaf roller and aphids are also controlled in these two sprays. Mites are suppressed while Guthion is used. *Cautions and suggestions:* Use respirator and follow all safety precautions.

DDD (50 percent wettable powder), 2 pounds, plus *malathion* (25 percent wettable powder), 2 pounds. Use in petal-fall and first cover sprays to control DDD resistant populations. Some added benefits in mite and aphid control.

Parathion (15 percent wettable powder). Use 2 pounds in petal-fall spray and follow with 2 pounds of parathion plus 2 pounds DDD in first cover spray. The addition of DDD in the first cover spray provides longer residual activity. If properly timed and applied, 2 pounds of parathion in the two sprays will control red-banded leaf roller. This program also controls plum curculio, mites, aphids, and other early season insects. *Cautions and suggestions:* See remarks under Plum Curculio Control, page 14.

Phosdrin (25 percent emulsifiable concentrate), ½ pint. Has controlled resistant red-banded leaf roller when used in petal-fall and first cover. Phosdrin can be used as an emergency treatment against larger first brood larvae at a rate of 1 pint. *Cautions and suggestions:* Phosdrin is highly toxic to humans. A special respirator should be used and all exposed portions of the body should be covered. Your county agent can supply you with the names of respirators recommended for use when spraying with Phosdrin.

Endrin (75 percent wettable powder), ⅓ pound. Applications in petal-fall and first cover have controlled resistant populations. Endrin will give some control of plum curculio but should not be relied upon in problem orchards. First application should be applied promptly at petal-fall for maximum effectiveness. *Cautions and suggestions:* Endrin is toxic to humans and a respirator should be used and all safety precautions followed.

Second Brood Control

Normal Populations (not DDD resistant)

DDD (50 percent wettable powder), 2 pounds. Use in two sprays according to timing given below.

Guthion (25 percent wettable powder), 1 pound. When used in a seasonal spray program, both normal and DDD resistant red-banded populations have been controlled. May be weaker than other programs if used in only two sprays in July and August. *Cautions and suggestions:* Follow all safety precautions.

DDD Resistant Populations

In order to obtain commercial control of DDD resistant populations of red-banded leaf roller, two applications of insecticides are required for the second brood. The first spray is normally applied in late July and the second spray in early August. The following programs, based on the ultimate market for the fruit or variety of fruit, are suggested:

Processed Fruit: (Two sprays with either program)

Program 1: Lead arsenate, 3 pounds, plus malathion, 2 pounds, or parathion, 2 pounds, or Phosdrin, ½ pint.

Program 2: DDD, 2 pounds, plus malathion, 2 pounds, or parathion, 2 pounds, or Phosdrin, ½ pint.

Fresh Fruit:

First spray (late July): Lead arsenate, 3 pounds, plus one of phosphates listed above.

Second spray (early August): DDD, 2 pounds, plus one of phosphates listed above.

McIntosh and phosphate susceptible varieties:

Any of the programs listed under Processed Fruit or Fresh Fruit, as long as parathion is not included in the spray mixture. Parathion is not recommended on McIntosh and related varieties.

CODLING-MOTH AND APPLE MAGGOT CONTROL

Materials

All amounts of insecticides are given in amounts per 100 gallons of dilute spray.

DDT (50 percent wettable powder), 2 pounds. Controls codling moth, apple maggot and white apple leafhopper. Bud moth control is possible with proper timing. Usually, there is a build-up of mites and red-banded leaf rollers in DDT sprayed orchards.

DDT (50 percent wettable powder), 2 pounds, plus lead arsenate, 2 pounds. Controls codling moth and is the best mixture for apple maggot control. Introduced primarily for use during the month of July at 12- to 14-day intervals for maggot and codling moth control.

Guthion (25 percent wettable powder), 1 pound. Excellent codling moth control when used in a seasonal program. Controls DDT resistant codling moth. Controls apple maggot, aphids, and suppresses mites. Guthion will control red-banded leaf roller when used in a seasonal schedule. *Cautions and suggestions:* Use respirator and follow all safety precautions.

Sevin (50 percent wettable powder), 1 pound. Has equalled DDT in control of codling moth and controls DDT resistant codling moth. One pound controls green aphids. Increase dosage to 2 pounds to control apple maggot. Lead arsenate, 2 pounds, added to a pound of sevin may give adequate protection against apple maggot.

DDT (50 percent wettable powder), 2 pounds, plus parathion (15 percent wettable powder), 1 pound. Suggested for use on DDT resistant codling moth. Controls apple maggot, European red mite, green apple aphid and two-spotted mite. Do not use on McIntosh or related varieties. If DDT is reduced to 1½ pounds, the interval between sprays will have to be reduced to control apple maggot. *Cautions and suggestions:* Use respirator and follow all safety precautions.

DDT (50 percent wettable powder), 2 pounds, plus malathion (25 percent wettable powder), 2 pounds. Recommended for use against DDT resistant codling moth. Controls apple maggot, bud moth, white apple leafhopper, and will give some control of mites.

Parathion (15 percent wettable powder), 1½ pounds. Excellent codling moth control. Also controls mites and green apple aphid. Not suggested as a full program but may be used in one or two sprays provided DDT or lead arsenate is added for apple maggot control or there is a 3- to 5-day interval between sprays. *Cautions and suggestions:* McIntosh and its relatives may be injured, even with the addition of ¾ pound of activated charcoal per pound of parathion used. The use of parathion and charcoal are discouraged after the second cover spray on these susceptible varieties because of either poor finish or danger of injury. Use respirator and follow all safety precautions.

Lead arsenate, 3 pounds. Control is adequate in orchards with light infestations of codling moth and apple maggot.

Diazinon (25 percent wettable powder), 2 pounds. Has equalled DDT in controlling codling moth, is a possibility for use on DDT resistant codling moth. Diazinon at 2 pounds will control apple maggot, aphids and suppress mites. *Cautions and suggestions:* Has caused russeting on Rhode Island Greenings, Baldwin, and Golden Delicious.

Diazinon (25 percent wettable powder), 1 pound, plus DDT (50 percent wettable powder), 1 pound, controls codling moth and apple maggot. Has controlled DDT resistant codling moth. Will control aphids and suppress mites.

Methoxychlor (50 percent wettable powder), 2 or 3 pounds. Two pounds gives fair codling moth control and 3 pounds good control. Used as a combined codling moth and apple maggot control program in late cover sprays. Not suggested for a full summer program.

Phosphamidon (Dimecron) (4 pound per gallon formulation), ½ pint, plus DDT, 2 pounds, or lead arsenate, 2 pounds. Good codling moth control. Will also control aphids and suppress mites. Apple maggot control may be weaker with DDT than with lead. Recommended on a *trial basis only. Cautions and suggestions:* Limited observations on fruit finish. Do not use on Golden Delicious.

MITE AND APHID CONTROL

Investigations conducted during the past few years indicate two basic programs for mite control—preventive programs and eradicative programs. A preventive program, through a single spray or multiple sprays of an acaricide, reduces mite populations to low levels

and prevents any build-up through the season. An eradicative program controls mites after they have increased sufficiently in numbers to damage the crop. A preventive program has been shown to be superior to the eradicative program.

Preventive Programs

All amounts of acaricides are given as 100 gallons of dilute spray.

Superior type petroleum oil (70 second viscosity rating or 100 second viscosity rating), 2 gallons. Applied in the green-tip or delayed dormant stage to control European red mite. The 70 second viscosity oil is believed to be less injurious to the tree and may be used with more green tissue showing. Oils will also control San José scale, lecanium scale and red bug. At 3 gallons in the delayed dormant spray, or 4 gallons in the dormant spray, controls fruit-tree leaf roller and scurfy scale.

Genite (50 percent wettable powder), 1½ pounds, or (50 percent liquid formulation), 1½ pints. One application in the pink stage shows promise as a substitute for oil against European red mite. Not effective against other insects.

Mitox (40 percent wettable powder), 1 pound. One application in the pink stage has given control of phosphate resistant European red mites. Not effective against other insects. Do not use after petal-fall.

Tedion (25 percent wettable powder), 1 pound. One application in the pink stage has controlled phosphate resistant red mites. No control of other insects.

Ovex (50 percent wettable powder), ¼ pound in the pink spray, ½ pound in the first, third and fifth cover sprays controls red mites and gives partial control of two-spotted mites. Controls no other insect.

Kelthane (18.5 percent wettable powder), ½ pound in the pink, first, third, and fifth cover sprays has controlled both red and two-spotted mites in experimental blocks. Recommended on a trial basis because of limited grower experience. Not effective against other insects.

Tedion (25 percent wettable powder), ½ pound in pink, first, third and fifth cover sprays has controlled both red and two-spotted mites in experimental blocks. Recommended on a trial basis. Effective only against mites.

Eradicative Programs

The following programs can be applied to control European red mite or the two- or four-spotted mites at pink and at petal-fall, or in any two applications spaced from 7 to 10 days apart beginning from petal-fall on. If earlier sprays have been omitted for European red mite, the two sprays of any of the following materials be applied no later than the first cover and 7 to 10 days later. Materials that are effective against aphids may be applied as needed.

Kelthane (18.5 percent wettable powder), 1½ pounds, has given excellent control of both red mite and two-spotted mite. Also effective against phosphate resistant red mite. Controls no other insect.

Parathion (15 percent wettable powder), 1 pound, controls both red mites and two-spotted mites; also controls bud moth and aphids. Injurious to McIntosh and its relatives and should not be used on these varieties. *Cautions and suggestions:* Use respirator and follow all safety precautions. European red mites may develop resistance if parathion is used over a period of years.

Trithion (25 percent wettable powder), 1 pound. One application in fourth or fifth cover spray will control codling moth, apple maggot and aphids. *Cautions and suggestions:* More than one application may cause severe leaf injury. During 1960, severe leaf injury and leaf drop occurred on Cortlands from a single application. Use respirator and follow all safety precautions.

Tedion (25 percent wettable powder), 1 pound, will control European red mite and two-spotted mites. *Cautions and suggestions:* Follow label restrictions for number of applications that can be used after bloom.

Ethion (25 percent wettable powder), 1 pound, has given good control of mites, including phosphate resistant populations. Will also control codling moth. *Cautions and suggestions:* Do not use for more than three sprays after first cover spray.

Demeton (22 percent liquid formulation), ¼ to ¾ pint. The normal recommendations would be ½ pint, but ¾ pint may be needed to extend systemic action of this chemical under certain conditions. Also control aphids. *Cautions and suggestions:* Use respirator and follow all safety precautions.

TEPP, (20 percent product), ½ pint; or (40 percent product), ¼ pint, controls mites and aphids but is of little value against other pests. *Cautions and suggestions:* Follow all safety precautions.

Malathion, Diazinon and Guthion, when used in summer schedules for codling moth and apple maggot control will help suppress mites. Other insecticides and fungicides that may be considered partial acaricides include glyodin and Karathane. DN-289 and Elgetol 318 kill some mite eggs when used for aphid control in dormant sprays, but mite control is erratic and a follow-up treatment is usually required.

Pears

LOCATION OF THE ORCHARD

Pear trees are customarily planted on moderately drained soils, although only deep well-drained, loam-textured soils can produce the best yields at the least expense. Poor drainage appears to increase the severity of fire blight damage.

VARIETIES

The pear industry in New York is based mainly on the Bartlett, which is well known by the public and is in wide demand. The Bartlett has excellent dessert and processing qualities, but other varieties also have satisfactory fruit and tree characteristics. Bartlett should still be the main variety for most commercial plantings. Other varieties, also recommended for commercial production, are listed in order of their ripening dates. Because pear trees require cross-pollination by insects, two or more varieties must be planted to assure fruit set.

Clapp's Favorite ripens 2 to 3 weeks ahead of Bartlett. Yellow-blushed, symetrical, attractive fruit softens quickly at center, but is acceptable for immediate processing and fresh fruit. Trees are vigorous but very susceptible to blight.

Bartlett, Yellow, generally large fruit is excellent quality for dessert or processing and can be stored about 2 months. Tree is moderately vigorous and susceptible to blight.

Gorham ripens 2 to 3 weeks after Bartlett. Yellow, generally large fruit is excellent quality for dessert or processing. Tree is vigorous but susceptible to blight.

Buerre Bosc ripens 5 to 6 weeks after Bartlett. Bronze, russet, generally large fruit is of excellent dessert quality but, because of its long tapering neck, is difficult to process. Tree is vigorous but very susceptible to blight.

Many other pear varieties are available—both old varieties for special purposes and newer ones that have not been fully evaluated.

ROOTSTOCKS

Bartlett seedling rootstocks are suggested for commercial orchards. French pear seedling is not widely used now, but has been in the past. Results have been satisfactory but perhaps more variable than with Bartlett seedling. *Hard end* and *pear decline* have been associated with the Oriental pear rootstocks. Quince rootstock used for dwarfing may be more susceptible to cold temperatures than Bartlett seedling. Trial plantings on quince can be suggested, but firm recommendations for large scale plantings cannot be made without further orchard observations. Many pear varieties will not produce a good union when budded directly to quince. A variety such as Old Home should be used as an interpiece. Pear trees on Old Home planted deeply enough to scion root may be satisfactory.

SOIL MANAGEMENT

Sod competition around young trees must be eliminated by cultivation, mulching, or herbicides. Cultivation or chemical weed control must be applied at or before the time tree growth commences. Cultivation should cease by the end of June.

Sod or sod-mulch is suggested for mature orchards. Temporary improvement in growth can be noted from cultivation, but long-term studies indicate yield and fruit size advantages with sod-mulch management.

FERTILIZATION

The amount of nitrogen applied to pear trees is dependent upon the severity of the fire blight problem. If fire blight is not a problem, heavier rates than those suggested might be profitable; if fire blight is a problem, perhaps no nitrogen should be applied. Urea foliage sprays can be used as a supplement or in place of soil application if desirable.

A number of New York pear orchards are deficient in potassium. A leaf-soil analysis will help determine the need for this element. Magnesium deficiency is generally not a problem in pear orchards in New York, although a few such orchards have been found. A liming program should be established as described for apple orchards. Pear trees respond to mulch applications. If an economical source of mulch is available, and fire blight is not a severe problem, a moderate mulching program is beneficial.

Table 7. Rates of nitrogen fertilization for pear trees

Tree age	Ammonium nitrate	10–10–10	
	Sod	Sod	Cultivation
Years	*Pounds*	*Pounds*	*Pounds*
1–2	—*	½–1	0–½*
3–5	—*	1½–2½	½–1½*
5–10	½–1	2–3	—*
10–15	1–1½	3–5	—*
over 15	1½–2½	4–8	—**

*All young trees, whether in sod or cultivation, should receive a complete fertilizer.
**Trees over 5 years of age should be in sod or sod-mulch.

Spray Schedule for Pears

A practical spray schedule for pears in New York must be built around the control measures required for fire blight and pear psylla. A grower does not have to apply all of the sprays, but should select from the schedule those needed to protect his particular orchard.

SPRING SPRAYS

Dormant spray

Time: Before the buds are showing green.

Insects: Pear leaf blister mite.

Recommended materials per 100 gallons:

Superior dormant oil, 70 second viscosity or 100 second viscosity .....3 gallons

Comments: If a self-emulsified oil is not used, 2 ounces of blood albumin (actual) can be used to emulsify spray oil. Systox, ½ pint, has been used as an emergency treatment to control blister mite. The treatment is applied early in the spring while the tree is growing vigorously. Systox is recommended on a *trial basis only.*

Late dormant spray

Time: From the stage when the blossom bud scales are loosened until green leaf tips are showing.

Diseases: Sooty blotch.

Insects: Pear psylla.

Recommended materials per 100 gallons:

Parathion .....1 to 1½ pounds

or

Guthion .....1 pound

or

Malathion .....2 pounds

Comments: The phosphate materials cause less injury than DN materials and allow more leeway in timing. Phosphates are not effective against sooty blotch. Psylla eggs are the primary target but adults are also killed. DNC materials, 1 gallon, applied in the green tip stage control both psylla and sooty blotch. If sooty blotch is not a problem, pear psylla eggs can be killed by DNC materials, 2 quarts or 2 pounds, or by DNBP materials at 2 quarts.

Pre-blossom spray

Time: Then the blossom buds begin to separate in the cluster.

Diseases: Pear scab.

Insects: Pear midge.

Recommended materials per 100 gallons:

Ferbam .....1½ pounds

or

Glyodin .....1 quart

or

Captan .....2 pounds

or

Elemental sulfur at manufacturer's directions.

plus

DDT .....2 pounds

Comments: Pre-blossom spray is needed only if pear scab or pear midge is a problem. DDT should be applied for pear midge when the blossom buds are swollen, but before the sepals have begun to separate, and again 7 days later when the flies are swarming.

Special bloom sprays for fire blight

Recommended materials per 100 gallons:

Streptomycin .....100 parts per million

or

Bordeaux mixture 2–6–100

or

Copper-lime dust 20–80

Comments: The choice of materials depends on the severity of the fire blight problem in the orchard. For a severe problem, use streptomycin exclusively. The first application should be made at any time after any of the blossoms are open and the following conditions exist or are expected within 24 hours: maximum temperatures of at least 65° F. plus rainfall; or maximum temperatures of at least 65° F. plus relative humidity of 60 percent or higher. If such conditions continue until ¾ of the blossoms are open, or recur at that time, a second application should be made.

A third application may be needed if conditions favorable to infection continue or recur later in bloom. No time interval can be suggested because the open blossoms apparently must be sprayed, and the time required to go from early to full bloom may be 24 hours or less. If the first application is not needed until ⅕ or more of the blossoms are open, it is likely that the second may be made at full bloom or later and the third will not be needed.

For a moderate problem use streptomycin when temperatures are 65 to 75° F. If temperatures are 75° F. or higher, use Bordeaux mixture or copper-lime dust.

For a light problem time application of Bordeaux mixture or copper-lime dust as above, but wait for temperatures of 70° F.

Petal-fall spray

Time: When last petals are falling.

Diseases: Pear scab, pear psylla.

Insects: False tarnished plant bug, fruit-tree leaf roller, green-fruit worms, plum curculio.

Recommended materials per 100 gallons:

One of fungicides listed under pre-blossom spray

plus

Parathion .....1 to 2 pounds

or

Guthion .....2 pounds

Comments: If pear psylla is not a problem, DDT, 2 pounds, or lead arsenate and lime, 3 pounds each, may be substituted. Two pounds of parathion are needed for curculio. If psylla is the only problem, wait until next spray to apply control measures.

First-nymph spray

Time: A week to 10 days after petals have fallen.

Diseases: Pear scab.

Insects: Pear psylla, plum curculio.

Recommended materials per 100 gallons:

Choice of fungicides and insecticides listed under the petal-fall spray.

Comments: Primarily for pear psylla, but pear scab and plum curculio may require attention.

Special spray

Time: About July 10.

Insects: Rose leaf beetle, quince curculio, sinuate pear borer.

Recommended materials per 10 gallons:

Lead arsenate .....3 pounds
Hydrated lime .....3 pounds
Spreader .....½ pound

Comments: If sinuate pear borer is a problem (usually in eastern New York), the lead arsenate and lime are increased to 5 pounds each, or 2 pounds of DDT is added to the spray mixture.

SUMMER SPRAYS

Early summer sprays

Time: In July when most of the second-brood psylla eggs have hatched.

Diseases: Pear scab, sooty blotch, Fabraea leaf and fruit spot.

Insects: Pear psylla.

Recommended materials per 100 gallons:

Parathion .....1 pound

or

Guthion .....1 pound

or

Malathion .....2 pounds

or

Sevin .....2 pounds

Comments: A fungicide may be added to the formula if pear scab is a problem. In summer sprays ferbam, 1 pound, has given excellent control of Fabraea leaf and fruit spot.

Late summer sprays

Time: Early in August.

Insects: Pear psylla and codling moth.

Recommended materials per 100 gallons:

DDT .....1 pound
Parathion .....1 pound

or

DDT .....2 pounds

or

Guthion .....1 pound

or

Sevin .....1 pound

Comments: Use DDT plus parathion if both codling moth and psylla are problems. Use DDT, 2 pounds, for codling moth only. Guthion and Sevin are of value for late season application to avoid excess residues on the fruit at harvest.

PHOSPHATE INJURY

A replicated test was conducted in Niagara County in 1956 to determine whether the phosphates were responsible for the browning of pear leaves in many orchards during recent years. No damage occurred in 1956 in any of the plots. Ferbam, glyodin, and captan were also included in the test. Results indicate that heat is the primary cause of browning injury. The severity of the injury may be increased by the phosphates and several other spray materials.

Cherries

LOCATION OF THE ORCHARD

The selection of a well-drained soil and a frost free site is equally or more necessary for cherries than for apples.

VARIETIES

Virus disease is one of the major factors limiting satisfactory yields in New York cherry orchards. When purchasing cherry trees, specify trees that are certified virus free or as nearly virus free as can be obtained. If virus-free trees are not available, you can contract with the nurseryman to produce them. Plant virus-free trees in isolated blocks and follow other precautions recommended by your county Extension Service for virus protection.

Tart Cherries

Montmorency, a self-fruitful variety, is the only one suggested for freeze-processing. Several strains of Montmorency exist. If virus-free trees are purchased from a New York nursery, the buds will probably originate from the Geneva Agricultural Experiment Station, and a suitable strain of Montmorency is assured.

English Morello has a small market outlet through juice manufacturers because of its dark red juice color. It, too, is self-fruitful.

Sweet Cherries

The market for sweet cherries in western New York is largely for processing into maraschino cherries. Here, the lighter colored cherries are preferred. For fresh fruit sales a darker colored cherry is preferred.

All varieties of sweet cherries are self-unfruitful. Two or more varieties must be planted together. Napoleon and Emperor Francis will not pollinate each other and must be planted with some other variety to insure a crop.

Napoleon is a maraschino type cherry. Fruit is large, bright red cheek over a yellowish background. Tree is large, vigorous, upright-spreading, very productive, but is below average in hardiness.

Emperor Francis is also a maraschino type cherry. The fruit is large, bright red over yellow, with a dark red cheek. Tree is medium to large, moderately vigorous, upright-spreading, productive and hardy. Emperor Francis is receiving considerable attention in commercial cherry sections.

Yellow Spanish produces fruit that is medium to large, light yellow with a red cheek. Tree is large, very vigorous, upright-spreading, productive and hardy.

Schmidt produces large fruit, black in color. Tree is large, moderately vigorous, upright-spreading, moderately hardy, but productivity is somewhat erratic.

Windsor produces large, liver-colored fruit with good quality. Tree is large, vigorous, upright-spreading, hardy and very productive. Windsor is the standard late sweet cherry and is the most widely grown variety in New York.

Hedelfingen produces large, black fruit that has very good quality. Tree is large, very vigorous, upright-spreading, hardy and productive. Considerable interest has developed in the variety in the past few years.

ROOTSTOCKS

Two rootstocks, Mazzard and Mahaleb, are commonly used in the propagation of the cherry. Mahaleb is desirable for the Montmorency sour cherry if the soil is deep, sandy, and inclined to be droughty. Mazzard rootstock should be used if the soil is of heavier texture. Montmorency on Mahaleb will show greater tree mortality on heavier textured soils than it will on Mazzard. On deep, sandy soil, however, the Mahaleb will show good survival. The trees will be smaller than Montmorency on Mazzard, but more prolific per unit area.

Sweet cherries should be propagated on Mazzard rootstock.

SOIL MANAGEMENT

Trashy cultivation with a disc harrow is suggested for most cherry orchards. Cultivation should be started as early in the spring as the ground can be worked and usually stopped by the end of June.

In some orchards a good stand of weeds follows cultivation and is satisfactory for a cover crop. If a cover crop must be sown, annual rye is a good choice, but it must be disced in the early spring. A cover crop that winter-kills, such as buckwheat, is preferred by some growers.

Recently, herbicides have been used in cherry orchards without harm to tree growth or yield. Regulations at present will permit the use of herbicides only on young non-bearing trees. Dowpon should be avoided as a herbicide in cherry orchards.

FERTILIZATION

Rates of nitrogen application suggested for sour cherry are listed in table 8. These rates are rough approximations, and adjustments must be made according to individual orchard conditions.

The rate of nitrogen fertilization needed for young sweet cherry trees in a cultivated orchard may be slightly less than for sour cherries of a comparable age. The sweet cherry grows to be a larger tree than sour cherry, however, and at about the age of 10 to 15 years, the rate should be perhaps only slightly less than suggested for apples. The highest rates of nitrogen fertilization are needed for cherry orchards in sod.

Nitrogen should be applied in the very early spring at or before the time of bud-break. Fall fertilization is not suggested for cherries.

Recent studies indicate that yield of cherries can be markedly increased by rates of potassium fertilization considerably higher than those needed to correct foliage deficiency symptoms. The leaf-soil analysis service can be of help in determining the need for potassium fertilization.

Magnesium deficiency is generally not a problem in cherry orchards, although a few such orchards have been noted. If the soil is acid and low in magnesium, dolomitic limestone should be applied to produce a surface soil pH of 6.0.

Table 8. Rate of nitrogen application suggested for sour cherry (cultivated orchard)

Tree age	NH_4NO_3	10–10–10
Years	*Pounds*	*Pounds*
1–2	*	¼–½
3–4		½–3
5–10	1–1¼	3–5
over 10	1½–3	5–10

*A mixed fertilizer is suggested for all young cherry trees.

Spray Schedule for Cherries

Under New York conditions, cherries are sprayed principally to control leaf spot, brown rot, and fruit flies. In some locations plum curculio may require attention. Black cherry aphid is confined primarily to sweet cherries.

SPRAYS FOR SOUR CHERRIES

Pre-blossom spray

Time: Just before the blossoms open.

Diseases: Brown-rot blossom-blight.

Recommended materials per 100 gallons:

Elemental sulfur .....5 pounds (actual)
or
Captan .....2 pounds

Comments: This spray is important in most seasons on English Morello, and may be needed in some years on Montmorency cherries.

Petal-fall spray

Time: When the last petals are falling.

Diseases: Brown rot, and leaf spot.

Insects: Plum curculio.

Recommended materials per 100 gallons:

Fixed copper .....¾ pound (actual)
Hydrated lime .....3 pounds
Oil-type sticker .....1 pint
or
Ferbam .....1½ pounds
or
Captan .....2 pounds
or
Captan .....1 pound
Ortho sticker .....½ pint
or
Glyodin .....1½ pints
or
Acti-dione .....1 part per million
or
Dodine (Cyprex) .....¼ pound
plus
Lead arsenate .....2½ pounds
Hydrated lime .....2½ pounds
or
Guthion .....1 pound
or
Parathion .....2 pounds
or
Methoxychlor .....2 pounds

Comments: Fixed copper is used at a rate of ¾ pound of actual copper. Ferbam, ½ pound, or Nu-Iron, ½ pound, should be included as an arsenical corrective with glyodin, acti-dione or dodine. Nu-Iron tends to decrease the effectiveness of acti-dione against leaf spot. Off-color and distortion of fruit was noted by some growers in 1960 when acti-dione was used in combination with flowable parathion. For a dusting schedule, growers should use a 90–10 sulfur-lead arsenate dust. If curculio is abundant, use an 80–20 mixture. Use one pound of lead arsenate on English Morello to reduce danger of arsenical injury (dry-stem).

Shuck spray

Time: When shucks are falling from the fruits:

Diseases: Leaf spot, brown rot.

Insects: Plum curculio.

Recommended materials per 100 gallons:
Refer to recommendations listed under petal-fall spray.

Comments: Stem-end injury to the fruit caused by fixed copper is generally avoided by using captan, glyodin, ferbam or dodine in this spray and the first fruit-fly spray.

First, second, and third fruit-fly sprays

Time: *First spray*—a week after fruit flies appear (about the time Early Richmond first shows a tinge of color). *Second spray*—about 10 days after first fruit-fly spray (about the time Montmorency begins to color). *Third spray*—about 10 days after the second fruit-fly spray.

Diseases: Leaf spot, brown rot.

Insects: Cherry fruit flies.

Recommended materials per 100 gallons:
Materials and suggestions are the same as listed under the petal-fall spray.

Comments: Diazinon, 2 pounds of the 25 percent wettable powder, may be substituted for lead arsenate in all three fruit-fly sprays. Recommended on a trial basis only.

After picking spray

Time: Soon after harvest.

Diseases: Leaf spot.

Insects: European red mite, two-spotted mite.

Recommended materials per 100 gallons:
Fixed copper .....¾ pounds (actual)
Hydrated lime .....3 pounds
or
Acti-dione .....1 part per million
or
Bordeaux mixture 2–6–100
or
Dodine (Cyprex) .....¼ pound

Comments: If mites are a problem in the orchard, any one of the following acaricides in the post-harvest spray will provide control: Ovex, 1 pound; parathion, 1 pound; malathion, 2 pounds; Diazinon, 1 pound; Tedion, 1 pound; or, Kelthane, 1½ pounds.

SPRAYS FOR CHERRIES TO BE USED AS FRESH FRUIT

Any of the insecticides mentioned for the petal-fall spray may be used up to the first fruit-fly spray. To insure that the residue will be safe when the cherries are to be used as fresh fruit, the fruit-fly sprays should be changed to one of the following formulas:

Fine ground derris or cubé powder.....2 pounds (containing from 4 to 5 percent rotenone)
plus
Wettable surfur.....At manufacturer's directions
or
Methoxychlor .....3 pounds
plus
Any fungicide listed under petal-fall spray....
....as indicated.

SPRAYS FOR SWEET CHERRIES

Dormant spray

Time: Before buds open.

Insects: Black cherry aphid.

Recommended materials per 100 gallons:
DNC materials .....1½ pounds or 1½ quarts
or
DNPB materials .....1 quart

Comments: Used to control black cherry aphid only. In some years the black cherry aphid has required control measures during the summer. TEPP, ¼ or ½ pint, parathion, 1 pound, or malathion, 1 pound, has given satisfactory control.

Pre-blossom spray

Time: Just before blossoms open.

Diseases: Brown-rot, blossom-blight.

Recommended materials per 100 gallons:
Dichlone (Phygon) .....½ pound
or
Captan .....2 pounds
or
Sulfur .....5 pounds (actual)
Oil sticker .....1 pint

Comments: Additional applications may be needed in bloom to control blossom blight. The danger of reducing fruit set by sulfur should be balanced against the danger of brown rot. Dichlone has given no injury when used in early sprays. Greenhouse tests indicate dichlone is effective up to 12 hours after the beginning of the rain. Promising results were obtained with captan against blossom blight. Captan has caused severe leaf injury, particularly to the Schmidt and Emperor Francis varieties of sweet cherries in sprays from petal-fall to pre-harvest.

Petal-fall spray

Time: When last petals are falling.

Diseases: Leaf spot, brown rot, Botrytis fruit rot.

Insects: Plum curculio.

Recommended materials per 100 gallons:

Captan .....2 pounds

or

Sulfur .....3 pounds (actual)

Ferbam .....¾ pound

plus

Choice of insecticides listed under petal-fall spray for sour cherries.

Comments: The captan or sulfur-ferbam mixture gives combined control of brown rot, Botrytis fruit rot, and leaf spot. If cool weather prevails in bloom, the use of the fungicides recommended may be started in bloom to control Botrytis fruit rot. *Copper sprays are unsafe for use on sweet cherries.*

Shuck spray

Time: When shucks are falling from fruits.

Diseases: Brown rot, leaf spot.

Insects: Plum curculio.

Recommended materials: Same as those listed under the petal-fall spray.

First, second, and third fruit-fly sprays

Time: *First spray*—a week after fruit flies first appear. About the time Early Richmond shows a tinge of color. *Second spray*—about one week after the first. *Third spray*—a week after second.

Diseases: Brown rot.

Insects: Cherry fruit flies.

Recommended materials per 100 gallons:

Fungicide as in petal-fall spray

plus

Fine ground derris or cubé powder.....2 pounds (containing from 4 to 5 percent of rotenone)

Comments: Lime or Bordeaux mixture should never be used with derris or cubé powder. For cherries to be used as fresh fruit, this schedule must be used. For cherries that are to be washed, the materials listed under the sour cherry schedule may be used. For growers who prefer to make only two fruit-fly sprays, it is advisable to use 3 pounds of derris or cubé powder instead of 2 pounds. Two applications may not give satisfactory control, particularly if there are rainy periods. Methoxychlor or parathion may be substituted for the derris on a trial basis if desired.

Pre-harvest spray

Diseases: Brown rot.

Recommended materials per 100 gallons:

Captan .....2 pounds

or

Sulfur .....3 pounds (actual)

Ferbam .....¾ pound

Comments: Captan may be used during harvest if desired for maximum protection against brown rot.

After picking spray

Diseases: Leaf spot.

Recommended materials per 100 gallons:

Glyodin .....1 quart

or

Ferbam .....2 pounds

Comments: Cyprex, at ¼ pound, may be used on a *trial basis.*

Peaches

LOCATION OF THE ORCHARD

Stone fruit trees, including peaches, require well-drained, frost free sites for satisfactory fruit plantings.

VARIETIES[2]

The following list of recommended peach varieties includes those for the roadside stand operator, local markets, and for shipping or processing.

Dixired ripens about 5½ weeks before Elberta. The fruit is medium to large, round, highly colored; flesh firm, mild flavor, semi-clingstone. Tree vigorous, productive, less hardy than Elberta.

Redhaven ripens about 4 weeks before Elberta. The fruit is medium size, round, red all over; flesh firm, pleasant flavor, and good quality. Tree vigorous, productive, and hardy. This variety is well suited to processing because the flesh turns brown slowly on exposure to the air.

Triogem ripens about 3 weeks before Elberta. Fruit medium to large, oval, attractive yellow and blush; flesh firm, good flavor and quality, freestone. Tree productive, medium hardy. One of the best varieties for freezing, canning or fresh use.

Sunhigh ripens about 2 weeks before Elberta. Fruit is large, oval, highly colored; flesh firm, good flavor, high quality, freestone. Tree is vigorous, medium hardy.

[2]Prepared by Professor R. C. Lamb, New York State Agricultural Experiment Station, Geneva, N. Y.

Halehaven ripens about 2 weeks before Elberta. Fruit is large, round, highly colored; flesh medium firm, fine flavor, high quality, freestone. Tree vigorous, productive, and hardy.

Early Elberta, depending on type, ripens from 3 to 10 days before Elberta. Resembles Elberta in appearance and quality. Stark's Early Elberta (3 days before Elberta) is the best of the types that has been grown at Geneva.

Redskin ripens slightly ahead of Elberta. Fruit is large, highly colored; flesh firm, freezing and canning quality good, freestone. Tree spreading, very vigorous.

Elberta ripens about September 15. Fruit is large, oval, yellow and blush; flesh firm, rather strong flavor, fair to good quality, freestone. Tree productive, widely adapted, tender to low temperatures. Suitable for shipping or processing.

Peach varieties are constantly being developed. Early Red, Royal Vee, Sunhaven, Richhaven, and Washington are all new varieties that appear to have promise but are not sufficiently tested to be recommended.

ROOTSTOCKS

Rootstocks used in the propagation of peach varieties are peach seedlings grown from seeds of the California freestone variety Lovel, or from seeds of a red-leaved peach seedling grown as a seed source in Tennessee. Both selections make satisfactory rootstocks.

Several Prunus species can be used to control size of peach trees, probably not necessary in commercial orchards.

SOIL MANAGEMENT

Peach trees are managed best with trashy cultivation. Cultivation should begin in the early spring about the time tree growth begins. Tillage should be no deeper than 3 to 4 inches, and should cease by the end of June except in dry seasons, when it may be needed until mid-July. After this time weeds may be allowed to grow, or a cover crop such as rye and vetch can be planted.

Peaches may be grown on a mulch system if the precautions described for cherries are followed.

FERTILIZATION

Most peach orchards will require nitrogen fertilization. The need for other nutrients can be established by soil or by soil and leaf analysis. Suggested rates of nitrogen fertilization are given in table 9.

Table 9. Rates of fertilizer applications suggested for cultivated peach trees

Tree age	NH_4NO_3 per tree	10–10–10 per tree
Years	*Pounds*	*Pounds*
1–2		¼–½
3–4		½–1
5–10	¼–½	1–1½
11–15	½–1	1½–3
over 15	1–2	3–6

A broadcast mixed fertilizer application such as 200 to 300 pounds per acre of 10–10–10 occasionally may be needed for cover crop growth. The rates suggested should be adjusted to individual orchard fertility.

CHEMICAL THINNING

Naphthylphthalamic acid (NPA) has label clearance for chemical thinning of peach orchards in 1961. Do not use dinitro materials unless further information becomes available; there is some indication that the dinitro chemicals may be given label clearance.

Peach thinning results with NPA have varied as is usual with hormone thinners. NPA should be applied as the petals are going off or 2 to 5 days following full bloom. Later sprays can cause serious leaf injury.

The concentration of NPA should be varied for different varieties and conditions. For Golden Jubilee, Summercrest, and Elberta, 100 to 150 parts per million is suggested; Red Haven and Halehaven will respond better to concentrations of 200 to 300 parts per million. Following a period of cloudy, rainy weather, the concentration for the different varieties should be kept in the lower range. Special care must be taken in spraying young trees. Even with Red Haven and Halehaven, a concentration of 150 parts per million should prove adequate for 4 to 5 year old trees.

Concentration means little unless dosage or gallons per tree is considered. For example, in a 1957 test where unsprayed Sunhigh trees set 36 percent, trees receiving 100 parts per million of NPA at 6 gallons per tree set 18 percent and trees receiving 200 parts per million at 3 gallons per tree set 16 percent. In this same test the 200 parts per million concentration at the rate of 6 gallons per tree resulted in only 6 percent set—overthinning. Because dosage may vary greatly with different growers, the dosage being used should be considered when deciding on a concentration. The above test indicates that a low dosage of a low concentration may result in little or no thinning, but a heavy dosage of a high concentration will likely overthin.

HERBICIDES

Regulations permit the use of two sprays of Dowpon for weed control in the early spring at the rate of 5 pounds per acre each on the area sprayed. The spray should be limited to within a 3 foot radius of the trunk. Peaches are susceptible to Dowpon injury, but this program avoids heavy Dowpon applications and should be safe under most conditions. So far, no other herbicide has clearance on bearing peaches.

Suggestion 1 as listed for apples is a possible treatment for non-bearing peaches.

Spray Schedule for Peaches

SPRING SPRAYS

Leaf-curl spray

Time: After leaves drop in the fall, or before buds swell in the spring.

Diseases: Peach leaf-curl.

Recommended materials per 100 gallons:

Ferbam ..... 1½ pounds
or
DNC paste ..... ½ gallon
or
DNC dry wettable ..... 2 pounds

Comments: Bordeaux mixture may be used at 10–10–100 in the fall or 6–6–100 in the spring. Injury to peach buds has been reported from a late spring application of 1 gallon of paste DNC (Elgetol). The DNBP materials (DN-289 and Elgetol 318) are not safe on peaches.

Pre-blossom spray

Time: When blossoms show pink or earlier if rain threatens.

Diseases: Brown-rot blossom-blight, peach mildew.

Insects: Tarnished plant bug.

Recommended materials per 100 gallons:

Phygon ..... ½ pound
or
Captan ..... 2 pounds
or
Sulfur ..... 5 pounds (actual)
plus
DDT ..... 2 pounds

Comments: Additional applications may be needed in bloom or at the petal-fall stage. The danger of reducing fruit set by sulfur should be balanced against the danger of brown rot. Greenhouse tests indicate Phygon is effective up to 12 hours after the beginning of the rain. Captan has caused some leaf injury to peaches in later sprays. If peach mildew is a problem, sulfur should be used alone or in combination with one of the organic fungicides. If tarnished plant bugs are a severe problem, DDT should be included. Do not use DDT during bloom.

SUMMER SPRAYS

The basic schedule involves the use of the phosphate materials, Guthion, parathion, or malathion, plus a fungicide. It is designed to control all of the major pests of peach and a number of minor pests with the exception of the Japanese beetle. The number of sprays given here have been carefully determined by experimental workers at the Geneva Experiment Station and represent the minimum number of sprays for a complete peach insect- and disease-control schedule.

First curculio or shuck split spray, second and third curculio sprays

Time: *First spray*—When first shucks start to split. *Second spray*—Seven to 10 days after shuck-split spray. *Third spray*—Seven to 10 days after second spray.

Diseases: Brown rot, peach scab, peach mildew.

Insects: Plum curculio, first brood oriental fruit moth, lesser peach tree borer, tarnished plant bug.

Recommended materials per 100 gallons:

Captan ..... 2 pounds
or
Thiram (Thylate) ..... 2 pounds
or
Elemental sulfur ..... 5 pounds (actual)
plus
Parathion ..... 2 pounds
or
Guthion ..... 1 pound
or
Malathion ..... 2 pounds

Comments: Peach mildew may build up in captan sprayed orchards. Sulfur will control mildew when used alone at full strength or at 1 or 2 pounds in combination with captan or thiram. Temperature has a great influence on the activity of the plum curculio. Adults are active at the beginning of shuck split and for a period of 3 to 5 weeks thereafter. When temperatures of 70°F. to 75°F. are reached on 2 to 3 successive days, curculio adults become active. If such temperatures are reached just before shuck split, injury can be expected immediately after the fruits are

exposed. Insecticides should be applied immediately. If there is a week of hot weather after shuck split, a 7-day interval is advised, especially where parathion and malathion are used. Guthion has somewhat longer residual activity. Dieldrin, ½ pound of 50 percent wettable powder, can be used to control plum curculio but it is not effective against the oriental fruit moth, and the overall program is materially weakened. Spray the trunks and scaffold limbs as well as the fruit and foliage to control lesser peach tree borers.

First oriental fruit moth spray

Time: From July 7 to July 15.

Diseases: Brown rot.

Insects: Oriental fruit moth, peach tree borers, cottony peach scale, European fruit lecanium scale.

Recommended materials per 100 gallons:
Choice of materials as listed under first curculio spray.

Comments: The spray is applied to trunks and scaffold limbs as well as to the foliage and fruit for maximum results, and is directed to the undersides of the leaves where the scale insects are a problem. If cottony peach scale or lecanium scale is a problem, it may be necessary to adjust the time of application for maximum control. Parathion or Guthion is effective for about 10 days after the beginning of the summer hatch of the crawlers of either scale until completion of hatch. If both scales are a problem, a spray at the completion of the cottony peach scale hatch normally will give protection against both species. Malathion is of little value against scale insects.

Second oriental fruit moth spray

Time: From August 1 to August 10.

Insects: Oriental fruit moth and peach tree borers.

Recommended materials per 100 gallons:
Choice of insecticides listed under first curculio spray.

Comments: Sprays applied at this time should have low enough residues to constitute no problem on varieties such as Golden Jubilee and those picked after Jubilee. Trunks of trees should be thoroughly sprayed to control the regular peach tree borer.

SPECIAL SPRAYS

A final treatment of captan, 2 pounds per 100 gallons, should be made just before harvest to protect against brown rot.

Sevin can be used within one day of harvest to control late season activity of the Oriental fruit moth. Sevin should be used at the rate of 2 pounds per 100 gallons.

In some years tarnished plant bugs invade the orchard during July and August. No practical schedule has been devised to protect against such attacks other than DDT, parathion or Guthion application at approximately 10-day intervals beginning at the onset of insect activity and continuing until activity ceases.

JAPANESE BEETLE SPRAYS

Because phosphates lose their toxicity to the Japanese beetle within 3 to 5 days, special measures must be taken in areas where the beetle is a problem.

In the southern part of the Hudson Valley where Japanese beetle infestations are heavy, fruit may require protection from mid-July to mid-August. Zinc dimethyldithiocarbamate (ziram), 1½ pounds in 100 gallons of water, is a good repellent to Japanese beetles and may be substituted in place of sulfur. If beetles attack ripening fruit, make a preharvest rotenone spray or dust, or a spray of ziram.

Prunes and Plums

LOCATION OF THE ORCHARD

Japanese plum varieties will grow best on the lighter soils; European varieties should have heavier type loams. Although plums will tolerate more moisture than peaches or cherries, moderate to good drainage is essential.

VARIETIES

Stanley is the best European prune type for commercial planting, although it suffers from the constriction disease discussed under rootstock. European varieties are most suitable for New York.

Italian Prune (Fellenberg) is a blue high quality prune type. It is not in so strong demand for processing as is Stanley, however. Many Italian prune trees are affected with a virus-like disease known as leaf-casting mottle that causes fruit to drop prematurely. A clone free of this condition is available from some nurseries and should be specified when Italian prune trees are ordered.

Stanley and Italian Prune are self-fruitful, although occasionally cross-pollination may help improve fruit set. European and Japanese varieties are not suitable pollinators for each other.

ROOTSTOCK

European type prunes are best propagated on the Myrobalan plum. Some strains of Myrobalan, when propagated with Stanley, produce a union incompatability or constriction disease. The disease may not be obvious until the orchard is 7 or 8 years old and has begun bearing. Strains of Myrobalan that may be free of the disorder are available from the New York Agricultural Experiment Station at Geneva. Double working the tree with an Italian Prune interpiece may help correct the trouble. Both of these control measures are tentative, however, for neither method has been given long orchard trials. Available precautions should be utilized, but planting the Stanley variety free of constriction troubles is not a certainty.

Occasionally plums are budded on peach seedlings, but these should be planted on lighter soils. Japanese-American hybrids are best propagated on American plum seedlings.

SOIL MANAGEMENT

Sod competition around young trees must be eliminated by cultivation, mulching, or herbicides. Cultivation or chemical weed control must be applied before or at the time tree growth commences. Cultivation should cease by the end of June.

Cultivation with a late summer cover crop, or sod with supplemental mulch, are both satisfactory as soil management practices for mature prunes and plums.

FERTILIZATION

Rates of nitrogen application suggested for prune trees are listed in table 10. These rates are rough approximations and adjustments must be made according to individual orchard conditions. Nitrogen should be applied in the very early spring at or shortly before the time of bud break.

Potassium is the major nutrient that may be deficient in addition to nitrogen. Magnesium deficiency has been observed, but is not a general problem.

Table 10. Rates of nitrogen fertilization for prune trees

Age	Sod		Cultivation	
	NH_4NO_3 per tree	10–10–10 per tree	NH_4NO_3 per tree	10–10–10 per tree
Year	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1–2				¼–½
3–4				½–1½
5–10	½–1½	1½–5	¼–¾	1½–2½
over 10	1½–3	5–10	¾–1½	2½–5

Spray Schedule for Plums and Prunes

SPRING SPRAYS

Green-tip spray

Time: As the buds break.

Diseases: Black knot.

Insects: Eye-spotted bud moth.

Recommended materials per 100 gallons:

Zineb (65 percent) .....2 pounds

plus

Parathion .....1 pound

Comments: If black knot is a serious problem, the green-tip spray should be made in addition to the regular summer treatments. Include parathion in this spray only if bud moth is a problem.

Pre-blossom spray

Time: Just before blossoms open.

Diseases: Brown-rot blossom-blight, black knot.

Recommended materials per 100 gallons:

Phygon .....½ pound

or

Captan .....2 pounds

or

Sulfur .....3 pounds (actual)

Ferbam .....1 pound

Comments: The pre-blossom spray controls brown-rot blossom-blight. Additional spray applications in bloom may be needed for the control of brown-rot blossom-blight. The danger of reducing fruit set by sulfur in bloom should be balanced against the danger of brown rot. If black rot and brown rot are not serious threats, the use of the sulfur-ferbam combination should give adequate control. Very satisfactory results have been obtained with captan for the control of brown rot. However, leaf and fruit injury frequently have occurred on Stanley prunes when captan was used in several continuous sprays early in the season.

First curculio spray

Time: When shucks start to split.

Diseases: Brown rot, leaf spot, and black knot.

Insects: Plum curculio.

Recommended materials per 100 gallons:

Sulfur ..... 3 pounds (actual)
Ferbam ..... ¾ pound
or
Captan ..... 2 pounds
plus
Guthion ..... 1 pound
or
Methoxychlor ..... 3 pounds

Comments: The remarks regarding temperatures given under peaches (page 26) also apply here. If curculio is a severe problem, dieldrin at ½ pound may be substituted for the listed insecticides on a trial basis. However, dieldrin materially reduces the effectiveness of the overall program. Parathion and Guthion suppress red mites. The fungicide should be repeated 2 to 3 weeks later to control leaf spot and brown rot.

Second curculio spray

Time: Seven to 10 days after first curculio spray.

Diseases: Brown rot, leaf spot, black knot.

Insects: Plum curculio, red-banded leaf roller.

Recommended materials per 100 gallons:

Zineb (65 percent) ..... 2 pounds
or
Sulfur ..... 3 pounds (actual)
Ferbam ..... ¾ pound
plus
Choice of insecticides listed under first curculio spray.

Comments: Zineb should be used if black knot is a problem. If methoxychlor is used to control plum curculio, 2 pounds of DDD should be added to control red-banded leaf roller. Parathion and Guthion are effective against the red-banded leaf roller.

Third curculio spray

Time: Seven to 10 days after second curculio spray.

Diseases: Brown rot, black knot.

Insects: Plum curculio, lecanium scale.

Recommended materials per 100 gallons:

Choice of materials listed under the second curculio spray.

Comments: In seasons of extended plum curculio activity, the third curculio spray may be necessary in western New York and a fourth in the Hudson Valley. In order to control black knot, it is essential to maintain coverage of all new terminal and lateral shoot growth during the growing season. In western New York, terminal growth is nearly completed by the middle of July. Black knots on the large limbs and trunk can be eradicated by cutting them out and treating the wound with a suspension of ½ tablet of actidione in 1 quart of water. The treatment should not be applied before the second week of July. All knotted tissue should be removed down to the wood and for 1 inch beyond the visible knotted area. It is suggested that all knots on small limbs be pruned out during the regular pruning season, removed from the orchard, and burned. If lecanium scale is a problem, a spray using parathion or Guthion should be applied from 16 to 20 days after the second curculio spray, or at the approximate completion of scale hatch. The undersides of the leaves must be thoroughly covered.

SUMMER SPRAYS

Pre-harvest spray

Time: Two or 3 weeks before fruit ripens.

Diseases: Brown rot, leaf spot.

Insects: Red-banded leaf roller.

Recommended materials per 100 gallons:

Fungicide listed under first curculio spray
plus
Guthion ..... 1 pound
or
Parathion ..... 1½ pounds
or
DDD ..... 2 pounds

Comments: For a dust schedule, applications of sulfur may be used. Guthion, parathion or DDD will control second brood red-banded leaf roller in early August. Guthion and DDD also will control apple maggot. In some orchards apple maggot causes considerable damage to prunes. In orchards not surrounded or bordered by unsprayed trees, the maggot may be controlled with 3 to 4 applications of DDT, 2 pounds of the 50 percent wettable powder. Applications should be started about June 20 in eastern New York and about July 1 in western New York and applied at 10-day intervals.

Mite control sprays

Time: Two applications, 7 to 10 days apart.

Insects: European red mite, two-spotted mite.

Recommended materials per 100 gallons:

Parathion ..... 1 pound
or
Kelthane ..... 1½ pounds
or
Tedion ..... 1 pound
or
Genite ..... 1½ pounds or 1½ pints
or
Ovex ..... 1 pound
or
Malathion ..... 2 pounds

Comments: Superior oil, 2 gallons of the 70 second viscosity or 100 second viscosity, can be used in the dormant or delayed-dormant sprays to control mite populations resistant to phosphates. Genite should be used in a pre-bloom spray only. Kelthane and Tedion have controlled resistant mites.

Quince

LOCATION OF THE ORCHARD

The quince apparently can grow on a wide variety of soils, but it thrives better on rather heavy clay loam. It is somewhat susceptible to cold injury and should be planted in the more moderate frost-free areas of the State.

VARIETIES

Orange is the leading commercial variety in New York and the most popular for home use. Quince varieties seem adequately self-fruitful.

ROOTSTOCK

Quince trees are best propagated on quince rootstocks from layers.

SOIL MANAGEMENT

Quince trees can be grown with trashy cultivation plus cover crop, or in sod with supplemental mulch.

FERTILIZATION

Apply nitrogen at about the rate suggested for pear trees.

Spray Schedule for Quince

SPRING SPRAYS

Dormant spray

Time: In spring before buds start to break.

Insects: Lecanium scale, European red mite.

Recommended materials per 100 gallons:

Superior type oil, 70 second viscosity or 100 second viscosity ..... 3 gallons

Comments: Apply when lecanium scale becomes abundant or for European red mite. Summer measures discussed under peaches and prunes may be used if this spray is omitted.

Pink spray

Time: When blossoms show pink.

Diseases: Fabraea leaf-blight and fruit spot.

Recommended materials per 100 gallons:

Bordeaux mixture 3–8–100

or

Ferbam ..... 1½ pounds

or

Elemental Sulfur ..... 5 pounds (actual)

Comments: Bordeaux mixture gives excellent control of leaf-blight and fruit spot, but fruit and leaf injury may be severe. Ferbam gives good disease control and sulfur gives fair control. Neither ferbam nor sulfur cause injury at this time.

Petal-fall spray

Time: When 90 percent of petals start to wither.

Diseases: Fabraea leaf-blight and fruit spot.

Insects: Codling moth, Oriental fruit moth, plum curculio.

Recommended materials per 100 gallons:

Bordeaux mixture 3–8–100

or

Ferbam ..... 1½ pounds

or

Elemental Sulfur ..... 5 pounds (actual)

plus

DDT ..... 2 pounds

SUMMER SPRAYS

The formula suggested in the petal-fall spray is advised for summer sprays except that sulfur is not suggested after the petal-fall spray.

The first application is made 10 days after the petal-fall spray. This spray controls leaf spot, leaf-blight and oriental fruit moth. If quince curculio is a problem, 3 pounds of lead arsenate is added to the formula.

Two or 3 applications after the petal-fall spray are usually enough to control leaf spot, leaf-blight, and quince curculio. If leaf-blight and fruit spot have been problems, 3 sprays are necessary and should not be more than 10 days apart.

For the control of oriental fruit moth with DDT, from 3 to 4 more applications should follow the 10-day spray at 19- to 21-day intervals.

DDD may be used in place of DDT during the first 2 weeks in August at the rate of 2 pounds of the 50 percent wettable powder in 100 gallons of spray to control red-banded leaf roller. The DDD should provide enough protection against oriental fruit moth.

Table 11. Pesticide residue tolerances and days from last application to harvest for fruit crops in New York State*

Material	Apples and pears		Cherries		Peaches		Plums and prunes		Quince	
	Tolerance	Days	Tolerance	Days	Tolerance	Days	Tolerance	Days	Tolerance	Days
	Parts per million		*Parts per million*		*Parts per million*		*Parts per million*		*Parts per million*	
Actidione			N.R.	4						
Arsenic, 2 pounds	3.5	30							7	30
Arsenic, 3 pounds	3.5	45								
BHC	5	60								
Captan	100	NTL	100	NTL	100	NTL	100	NTL		
DDD	7	30					7	30	7	30
Dichlone (Phygon)	3	1	3	3	3	7	3	3		
Dodine (Cyprex)	5	7	5	[a]						
DDT	7	30			7	30	7	30	7	30
Demeton	.75	21								
Diazinon	.75	14	.75	10						
Dieldrin	.25	35	.25	30	.1	45	.1	45		
Endrin	N.R.	**								
EPN	3	21	3	21	3	21	3	21		
Ethion	1	60								
Ferbam	7	7	7	7	7	21	7	7	7	7
Genite	N.R.	**								
Glyodin or Glyoxide	5	**	5	7						
Guthion	2	15	2	15	2	21	2	15		
Kelthane	5	7	5	7	10	14	5	7		
Karathane	N.R.	21								
Lead arsenate, 2 pounds	7	30	7	30/14†						
Lead arsenate, 3 pounds	7	45	7	30/14†						
Lindane	10	60								
Malathion	8	3	8	3	8	7	8	3		
Mercury	0	**								
Methoxychlor	14	7	14	7	14	21	14	7		
Mitox	3	**								
Niacide A	7	7								
Niacide M	7	0								
Ovex	3	30	N.R.	**	3	30	3	30		
Parathion	1	14	1	14	1	14	1	14		
Phosdrin	.5	1								
Phybam-S		**								
Sevin	10	1			10	1				
Streptomycin	N.R.	125–165								
Tedion	5	NTL	5	NTL	5	NTL	5	NTL		
TEPP	0	3	0	3						
Trithion	.8	30								
Ziram					7	[b]				
Zineb	7	7					7	45		

*Petroleum oil, ryania, rotenone, pyrethrum, sulfur and copper are exempt from a tolerance and may be used at any time consistent with good agricultural practices.

**Will not exceed residue tolerance at harvest if used according to recommendations.

†30 days (fresh fruit), 14 days (processing fruit).

N.R. no residue.

NTL No time limitations—follow label recommendations.

[a]only on sour cherries.

[b]remove excess residues.

SAFETY WITH INSECTICIDES

The organic phosphate materials, TEPP, parathion, Phosdrin, Guthion, Trithion, and demeton (Systox), are highly poisonous to man if improperly used. Endrin, although not a phosphate, is also hazardous to use. All chemical poisons should be treated with respect. The following precautions should be followed when using these materials:

1. The greatest danger from the phosphates in a wettable powder formulation appears to be in putting the wettable powder from the bag or can into the spray tank. Be careful at this point. With liquid formulations, the greatest danger is in measuring the materials. Avoid splashing the liquid on any portion of the body.

2. Wear a respirator with a filter for powders and an activated charcoal filter for organic vapors. Check charcoal filter to be sure it is labeled for the phosphate you are using. Change the filter after the number of hours specified. Phosdrin requires a special respirator.

3. Wear natural rubber gloves when handling insecticides.

4. Protect the body from wettable powders, liquid formulations, and from spray drift. Wear rubber or plastic coats, or wash your clothes every day.

5. Symptoms of poisoning are headache, nausea, pinpoint vision, constriction of the chest. If the above symptoms appear, do not delay—**see your doctor.** The antidote is atropine sulphate and cannot be obtained without a doctor's prescription. It is wise to have atropine sulphate on hand, but first see your doctor and follow his recommendations for using the atropine sulphate. An overdose can be **poisonous.**

6. Do not thin or remove suckers for several days after phosphate applications. Handling insecticides safely is similar to driving an automobile or handling fire. If certain precautions are followed, these useful instruments and materials can be used to advantage. If misused, they can do serious harm.

POISON CONTROL CENTERS

New York City	New York City Department of Health, Dr. H. Jacobziner WO 4-3800, Extension 680
Albany	Albany Hospital Albany 8-4541
Buffalo	Buffalo Children's Hospital Summer 5100
Elmira	Elmira Poison Control Center St. Joseph's Hospital 555 E. Market John J. Reed 36541
Hempstead	Hempstead Poison Control Center Meadowbrook Hospital Bethpage Turnpike and Carman Ave. A. W. Freirsich Ivanhoe 9-4000
Kingston	Kingston Poison Control Center Kingston Hospital 396 Broadway William E. Askue Federal 13131
Niagara Falls	Niagara Falls Memorial Hospital 516 Sixth Street A. E. Schvemaker Butler 52571
Rochester	Strong Memorial Hospital GReenfield 3-400, Extension 2247
Syracuse	Syracuse City Hospital, Renwick Ave. Dr. Paul Wehrl SYracuse 4-3161

TRADE NAMES

To simplify the presentation of information in this bulletin, products are sometimes referred to by their trade or brand names. This information is supplied with the understanding that no discrimination is intended and no endorsement by the New York State Extension Service is implied.

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